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MISSOURI BOTANICAL GARDEN BULLETIN

VOLUME XXVI

WITH 30 PLATES AND
18 TEXT-FIGURES

1938

ST. LOUIS, MISSOURI

PUBLISHED MONTHLY EXCEPT JULY AND AUGUST,
BY THE BOARD OF TRUSTEES

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ONE DOLLAR A YEAR SINGLE NUMBER FIFTEEN CENTS

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Vol. XXVI JANUARY, 1938 No. 1

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OF THE MISSOURI BOTANICAL GARDEN

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and while virtually a private garden it was, except at certain stated times, always open to the public. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was designated by Mr. Shaw as its official title and in his will or in any of his writings he specifically referred to it as the "Missouri Botanical Garden." By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will, the immediate direction of the Garden is vested in a Director, appointed by the Board of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises 75 acres, where about 12,000 species of plants are growing. There is now in process of development a tract of land of over 1,600 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees, and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a wild-flower reservation, with the idea that possibly at some future time this may become the new botanical garden.

The Garden is open to the public every day in the year, except New Year's Day and Christmas—week days from 8:00 a. m. until sunset; Sundays from 10:00 a. m. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Place, on the Sarah car line (No. 42). Transfer south from all intersecting lines.

SCENE AT THE TROPICAL STATION, BALBOA, C. Z.

Missouri Botanical Garden Bulletin

Vol. XXVI JANUARY, 1938 No. 1

FORTY-NINTH ANNUAL REPORT OF THE DIRECTOR

To the Board of Trustees:

The Director of the Garden has the honor to submit his report for the year 1937.

As has been pointed out in the past, these annual reports are designed primarily to serve as a record of a year's accomplishments. The temptation to indulge in prophecy or to dwell on difficulties, financial and otherwise, is resisted. Such matters, while important from an administrative standpoint, are best presented at meetings of the Board. They apparently do not interest the public; at least there has as yet been no tangible evidence of such an interest. Consequently what follows, prepared with the assistance of all the members of the Garden staff, is merely an attempt to list under the various departments the more important items of the year. Except where it is desirable from the standpoint of record, all matters of a purely routine nature are omitted. Their inclusion would burden the report with details that might cause even fewer to attempt to read it through. For those, and there are many, who are keenly interested in the Garden and its work, enough is included to give a general idea of the accomplishments and activities of an institution provided for the benefit of the student, the specialist, and the gardener, through the remarkable foresight and generosity of Henry Shaw.

Mention should be made of the unusual opportunity offered the Garden through the attendance of members of the Garden Club of America at their annual meeting in May. The presence of this distinguished group of plant lovers and experts warranted a special issue of the Bulletin containing information of a general

character pertaining to the orchid collection, the Arboretum, and the library. Some thirty exhibits illustrating the way plants respond to various environmental conditions were arranged, as well as demonstrations relating to the intensive study of trees and their needs, now being conducted at the Garden. By dividing the delegates into groups it was possible for all to have the opportunity of viewing the principal outdoor and indoor collections. The showing of colored moving-pictures of floral displays and special gardens, not at their best in early spring, helped to convey an idea of the activities of the Garden throughout the year.

Because of developments at the Tropical Station and the Arboretum and the inauguration of a new project involving coöperation between the Board of Education and the Garden, these activities are reported first, abandoning the somewhat time-worn order of previous reports.

TROPICAL STATION, BALBOA, C. Z.

Mr. Paul Allen took charge of the Station as resident manager in October, 1936. Following is a report of some of his activities during the period of October 1, 1936, to December 1, 1937:

One of the first tasks undertaken was the rearrangement of the orchid plants according to genera. They had been scattered rather promiscuously over the grounds, with representatives of twenty-five or more species often placed on one rack. The new arrangement aids greatly in the care of the plants, as well as making them more attractive to the public.

Most of the orchid racks on the premises were of wood, many of them dating from Mr. Powell's time. All were in deplorable condition, due to the attacks of termites and to natural decay. It was found necessary to begin their replacement with racks of pipe set in cement and covered with wire mesh. The one new unit built is 35 by 9 feet, with room for about 600 plants, and replaces 8 of the old wooden racks. Two pipe supports for hanging plants were found to be in unfavorable locations and were removed, the pipe being used in construction.

Due to the more compact nature of the new pipe unit and to the removal of two badly decayed trees, quite a large level area was left vacant. Since this had a good exposure to the sun and a very

NEW LILY POOL AT TROPICAL STATION, BALBOA, C. Z.

CERRO HORQUETA, FROM THE SIDE OF VOLCAN DE CHIRIQUI

COLLECTOR'S CAMP ON THE PORTRERO NEAR SUMMIT OF VOLCAN DE CHIRIQUI

attractive natural backing of palms, the site was used for a small water-lily garden. The pool measures 24 by 22 feet, and 24 inches in depth. The construction is of rough stone set in cement. At present it holds fourteen specimens of the Missouri Botanical Garden hybrid tropical water-lilies. The soil removed in the excavation of this pool was used in filling low areas where water stood during rains, and in making an even grade for a lawn. After the grading was finished the area was plugged with Java grass, which is being kept mowed.

The removal of the wooden racks left the small gate very much "off center." As the posts were badly termite-eaten, they were replaced by a new archway of pipe and wire which was put directly in the center between the two large royal palms. The flowering of the water-lilies has attracted a much greater number of visitors. They often came at inopportune times, for instance, just after heavy rains, and were causing a great deal of damage to the lawn. To obviate this, a walk resembling flag-stones as nearly as possible was built from the gate to the small stone bridge, with a lateral line around the side of the pool.

One of the projects outlined by Mr. Hunter before his death was the installation of a new water line. The Station had been trying to get enough water to carry through the bone-dry period from December to May with only a three-fourth-inch water main. The lack of pressure made it impossible to use more than one sprinkler at a time. Also there was danger that the old line, which was badly rusted, might break during the dry season and cause considerable damage during the time necessary for repairs. A new water main of 2-inch galvanized iron pipe was run for the 500 feet from the street, with 2-inch, and 1½-inch, lateral spurs at strategic points, for future use if necessary. All other lateral lines from the main have cut-off valves which can be closed when repairs are needed without depriving the rest of the garden of water. Five more taps have been added.

Quite a few trees, shrubs, and undesirable brushy growths were cleared away for the better view of specimen plants. Several large specimen palms were moved to better locations. About 60 new trees, shrubs, and vines were planted during the year, from material supplied by the Experiment Garden at Summit. The Di-

rector, Mr. Walter R. Lindsay, has been most helpful in this way, and in advice as to culture.

The collection of Sobralias has been augmented. These orchids are of the easiest culture, being grown as shrubbery, and supply a luxuriant display of flowers. A hedge of them has been planted the 150 feet from the gate to the entrance. Since the shrubs are semi-epiphytic in habit, they are mounted on piles of stones, as they are often found in the wild. During one recent show over 1200 flowers were counted, and even more may be expected when the plants have established themselves. *Sobralia panamensis* dominates, but there are scattered clumps of the large white-flowered variety.

The Manager's residence showed the need of paint badly and the entire exterior was repainted. Among other routine work was pouring of two concrete spatter basins to prevent two of the roof drains from ruining the lawn. Copper tag labels were hung on all the more important trees and shrubs. The work of cultivation, grass cutting, and repotting went on as usual.

Due to the poor nature of the soil, it is necessary to use fertilizer on all the more important plantings. It has proven best to make two applications, one during the heavy rains of October-November to put the plants in good condition for the coming dry period, and another at the beginning of the rains in May. Thus far the commercial fertilizers have been most satisfactory. A phenomenal growth has been secured from their use on plants of *Ravanala madagascariensis, Spathodea campanulata,* and Mahogany, the Ravanala having made over eight feet of growth in less than a year's time.

The most serious pests encountered are the leaf-cutting ants. A fairly effective method of control seems to be blowing up the nests with ignited carbon bisulphide. A new preparation of a sticky nature painted on the trunks of trees, precluding the passage of the ants, was tried with more or less success. Its drawback seems to be that it often burns the bark of very young trees. Within the last month a tin guard has been used which up to the present is working well but has not had sufficient trial.

Another pest is a small tan weevil which punctures the leaves of the plants. It is very hard to see, and the damage is usually

done before its presence is realized. It will probably be necessary to enclose the choicer plants in a screened house.

Permission was granted by the Chief Quartermaster for the use of an additional concrete shed near the Station for storage purposes. This has proved a great convenience.

On the night of September 1, fire broke out in the Manager's residence, destroying or damaging all of the flooring, downstairs doors and windows, and the paint both inside and outside of the house. The entire summer's collection of plants made by Dr. Robert E. Woodson, Dr. George W. Martin, and Mr. Russell Seibert was lost.

A system of exchange of plants with other countries, begun by Mr. Powell, had been discontinued for some years. During the year it was re-established and exchanges were made with the following countries: India, Colombia, Almirante R. de Panama, Siam, Trinidad, Guatemala, Java, Costa Rica, and Australia.

Below is a partial list of the more interesting species received.

Aerides crassifolium
A. falcatum
Calanthe vestita var. *gigantea*
Catasetum Russellianum (these plants were received as *C. Scurra* from Guatemala, but proved to be a very attractive type when flowered)
Cattleya Bowringiana
C. Dowiana
C. Dowiana var. *aurea*
C. Eldorado
C. gigas
C. maxima?
C. Skinneri
C. Skinneri var. *alba*
Dendrobium bigibbum
D. Dalhousieanum
D. formosum giganteum
D. Friedrichianum
D. Griffithianum
D. macrophyllum
D. Phalaenopsis
D. Phalaenopsis var. *Schroederianum*
D. Statterianum
Eulophia graminea
Grammatophyllum speciosum
Laelia rubescens
Oncidium Kramerianum
O. Lanceanum
O. Papilio
O. splendidum
Renanthera alba × *Vanda teres gigantea*
Saccolabium giganteum
Thunia Marshalliana
Vanda Denisoniana
Vanda "Miss Joaquim"

Two shipments of orchid plants have been handled by the Station for reshipment to the Garden in St. Louis. One from Brazil of 200 *Oncidium varicosum Rogersii* was cleaned before being reshipped. The other, a collection of *Cattleya speciosissima* from Venezuela, was separated and potted, and is being held until next spring.

The principal collecting work for the herbarium was undertaken during the visit of Dr. Robert E. Woodson, Dr. G. W. Martin, Mr. Russell Seibert, and Mr. Robert Simon during the summer. Unfortunately practically all of this material was lost at the time of the fire. The regions visited were: vicinity of Las Tablas, Los Santos Province, Taboga Island in Panama Bay, Chepo in the Province of Panamá, El Valle de Anton and vicinity in Coclé Province. Dr. Woodson, Dr. Martin, Mr. Seibert, and Mr. Simon visited the region above the finca of Mr. T. B. Mönniche, and through courtesies afforded by him were able to make the ascent to the top of Chiriquí Volcano. Mr. Seibert spent about six weeks alone collecting in the Volcan section of Chiriquí. During the stay of other members of the party on Barro Colorado Island, he and the manager made a collection in the lowlands of eastern Chiriquí Province, along the Rio Tabasará, and in the hills of western Veraguas Province.

A larger number of trips, principally in Panamá and Coclé provinces, were made for the collection of orchids for the Station and for exchange. Collections of herbarium material were made in the following locations: Rio la Maestra, Panamá Province near the Darien line, El Valle de Anton, Coclé Province, vicinity of El Real and Pinogana—Yavisa Trail, Darien Province as well as vicinity of Yape and Rio Tuira, Darien—and both sides of the Volcan; in the company of Mr. Walter R. Lindsay, Director of Summit Garden, vicinity of Cañazas, and over the line into eastern Chiriquí Province from Veraguas, where courtesies were shown by Mr. and Mrs. T. B. Mönniche. Specimens of one of the giant bamboos were secured in flower and fruit. These seem to seed only every thirty years or so.

Notices having been put in the local papers of shows of especial interest, many tourist parties and Canal Zone residents visited the Station to see the fine displays of *Cattleya Deckeri* and the Sobralias. Talks have been given to the classes of the Balboa Schools, the Instituto National de Panama, Scout leaders, and to Y. M. C. A. groups.

A new room was fitted out for visiting collectors, and will be maintained for their use. Visitors of note during the year have included Dr. Raymond L. Ditmars of Zoological Park, New York,

Dr. W. T. Baerg of the University of Arkansas, Dr. W. C. Muenscher of Cornell University, Dr. H. S. Fawcett, of the California Agricultural Experiment Station, and Dr. George W. Martin of the University of Iowa.

THE ARBORETUM

During the year the intensive development of the wild-flower gardens at Gray Summit has proceeded along a number of lines. A popular discussion of certain aspects of the work was included in the special Garden Club number of the BULLETIN, and a detailed report on the showier wild flowers was published in the BULLETIN for October. In those articles, as in the following report, it is convenient to discuss various phases of the work more or less independently. It should be emphasized that this division is artificial and purely a matter of convenience. The maintenance, development, and study of the wild-flower gardens are all interrelated parts of a single comprehensive program.

Trails.—The system of trails has been revised. Three types of trail are being developed: 1. A compact system of broad paths for the use of the general public; 2. A comprehensive set of narrow pathways for the use of the staff and of groups of students who visit the area. These are designed in such a way that they will require practically no maintenance when once established; 3. A system of emergency roads which can be used by the truck.

Vegetation.—During the winter of 1936-37 the area was mapped as to its plant cover; the vegetation being classified as white-oak sugar-maple forest, open glade, flood-plain forest, etc. At this time all the boundaries of the Arboretum were examined with reference to their precise location and the condition of the fencing. For the management of the area it is desirable that as complete a history as possible be assembled of the uses of the land since it was first settled. A beginning was made by examining the deeds to the entire property and preparing a diagrammatic map showing the exact history of each parcel of land. It was found that the land was first taken up from the government about a hundred years ago, as a series of small farms which were gradually combined into a few large ones.

In order to have a precise basis for studying possible future changes in the vegetation, key areas have been selected and the plant cover accurately mapped. A set of photographs is also being assembled which will give a record of the present state of the vegetation.

Management.—As related in the October BULLETIN, the study of the flora has revealed the weak spots in the wild-flower gardens. The most serious of these is the lack of natural meadows. Two meadow-like areas are already being developed (with apparent success), and two more are scheduled for work in the early spring.

Two urgent problems, the disposal of dead wood and the control of erosion, are particularly grave because of the general history of the area, much of it having been extensively pastured and lumbered before the Garden acquired the property. These two problems have been simultaneously solved by using the dead wood, wherever it occurs, to control erosion and build up humus in that particular area. Gullies are being filled up and dammed, and sheet washing on steep hillsides is retarded by laying the dead wood along the contour lines. The areas which have been treated in this way present a more attractive appearance, and soil and dead leaves are already accumulating behind the barriers.

Flora.—During the flowering season attention was centered upon the study of the flora. Over 500 species and varieties have now been collected, identified, and pressed. Since there are probably not more than 700 in the area, another season should complete this project for all practical purposes. The specimens are being kept as a special collection for reference and study at the Arboretum. All but a few of the identifications have been checked and several critical species have been sent to specialists.

It is planned to make detailed studies of variation in all the genera which are represented by more than one species. Preliminary work is already under way for several genera. The botany department greenhouses at Washington University are being utilized for the experimental study of the more complex groups. Progeny tests of two species and hybrids of the genus Aster and of two species of Elymus were begun last year and will be completed by next spring. Similar work has been started with Leavenworthia and several other winter annuals. With the com-

pletion of the basic taxonomic flora the next big project will be a cytological survey of the same material. In so far as possible the chromosome numbers and configurations of all the species and varieties in the area will be determined. This work is now getting under way, and a few chromosome counts have already been made.

Assistance.—Mr. Lewis Brenner, Jr., a junior at Washington University, assisted during the summer with the horticultural aspects of the above program.

The wild-flower gardens are already performing a useful function by serving as a convenient point where qualified botanists may study particular problems connected with the flora of the Ozarks. There has been a number of such visitors during 1937, some of whom stayed for several hours and others for several days. Among those who made actual use of the area were Dr. Walter Robyns, Director of the Jardin Botanique de l'État, Brussels, Belgium; Dr. Hiram Showalter, Professor of Botany, Kings College, Bristol, Tenn.; Dr. C. Leo Hitchcock, Assistant Professor of Botany, University of Washington; Dr. Norman C. Fassett, Assistant Professor of Botany, University of Wisconsin; Dr. H. D. MacGinitie, of the department of biology and geology, Humboldt State College, Arcata, Calif.

Nurseries and Plantations.—Slightly more than the usual number of seed were planted in beds and cold-frames, and about 5,000 small plants were shifted from frames to nursery beds and nursery rows. Three and a half acres, planted to cow-peas, were prepared for a new conifer nursery. Over 2,000 larger trees and shrubs were removed from the nurseries to permanent locations in various places on the grounds. Progress was made in the grading and planting around the entrance gateway, and the necessary maintenance of gravel roads, orchards, and collections was supplied as far as possible. Painting of buildings proceeded according to schedule.

Orchid Range.—The greenhouses at the Arboretum are devoted almost exclusively to the collection of orchids now comprising some 20,000 plants. During the year 18,135 plants were repotted, and orchid flowers either cut or displayed on the plant numbered 16,480. The old well at the garage having failed, it became neces-

sary to sink a new one. A well 360 feet deep was driven and the new pump housed in a brick structure adjoining the pump-room of the heating plant, a much more convenient location.

Sunshine Record.—For the past six years comparative records have been published showing the number of hours of sunshine at the Arboretum and the St. Louis Garden. Over this period the average number of sunshine hours at the Arboretum has been 142 hours in excess of that at the city. The advantage of this excess becomes more important when it develops that practically all the extra sunlight comes in the late fall and winter months, when the plants need it most. The record for 1937 follows:

	St. Louis Garden	Arboretum, Gray Summit
January	72	106
February	123½	129¼
March	145½	183½
April	160	171
May	214	224½
June	229	246
July	269½	288
August	259	280¾
September	255	241¼
October	175	189
November	126½	165¼
December	57	65
	2086	2289½
		2086
Excess sunshine hours at Arboretum		203½

SUPERVISED INSTRUCTION FOR SCHOOL CHILDREN

For many years school children, accompanied by their teachers or in non-conducted groups, have visited the Garden. Sometimes it would be to see a flower show, again to collect leaves from trees or to study a particular group of plants. A guide was sometimes furnished when one of the Garden employes was free for such service, but since it was no one's particular business it was a very unsatisfactory arrangement.

Realizing that the opportunities were unique and that the children should be getting much more from their visits than was then the case, the Garden presented the whole problem to the Superin-

tendent of Schools. Dr. Gerling at once became interested, and as a result of his recommendation the Board of Education authorized the appointment of a Special Nature Study Teacher, to be available at the Garden as guide and instructor during the school year. Miss Clara M. Heising, the one selected for this purpose, began her work in October, 1936. Her office is located at the main entrance of the Garden, and all visits of schools are arranged for through her. For the first time in the history of the Garden, school children have the opportunity not only of enjoying an hour or two among the flowers, but also of learning as they go, and they carry away with them information that is seldom imparted under such favorable circumstances.

During the year over 8,000 pupils from the elementary and high schools of the city have had the benefit of "lessons" in the Garden. The word is used advisedly, although the children may not realize they are being taught. By suiting the lesson to the age and grade of the class, and selecting from the wealth of material those things calculated to be most interesting, the pupils become enthusiastic about a topic that in the schoolroom would be dull and very often profitless. A partial list of the activities of the children will give an idea of the scope of the work and the benefits to be derived. The nature lesson is correlated with the social studies wherever and whenever possible.

Lessons.—Plants used for food, beverages, clothing, and shelter. Making useful things from plants in the Economic Garden was encouraged, for instance, tiny brooms from broom-corn, coarse paper from papyrus, thread from cotton, etc. One group used buckwheat seed for manufacturing flour, which after adding the necessary ingredients was baked into a pancake. Taken to school and sampled, it was pronounced good by all who tasted it. Such exercises bring about a better understanding of the industries essential to daily comfort, as well as a growing interest in the life of the farmer, the miller, the merchant, and the manufacturer.

Plants, their growth and development. Nature's way of reproducing plants, contrasted with the gardener's methods. Recognizing the common flowers and seeds. The State flower. Color harmony and an appreciation of beauty in nature. The inspiration that comes from a garden. Harm caused by vandals and thoughtlessness. Smoke.

Trees, how to recognize them. The story of a twig. Some problems of a tree and how it solves them.

Insects, beneficial; pollination. The controls of insect pests. Observation of activities of ants, bees, beetles, spiders, crickets, dragon-flies, etc.

Birds and other animals. Recognizing birds by their flight and call. Observing the flight of purple martins, the night-hawk, a large flock of pelicans. The nest-building, brooding, and feeding habits. Protecting and attracting birds. Their value to the farmer. Lessons on earthworms, frogs, crawfish, squirrels, rabbits.

In addition to the actual lessons of which the above are but a few examples, it has been possible to stimulate indirectly an interest in such things as careful and accurate observation, as well as some appreciation of how dependent we are upon nature. Through visits to Henry Shaw's tomb, the seedlings from Daniel Boone's Judgment Tree, the oak from Mt. Vernon, the Osage orange, the ginkgo tree, and the cycads, a new approach to history, both ancient and modern, is afforded.

As a result of this effort, the Garden has come really to mean something to the school children of St. Louis. Their eyes have been opened to facts with which they have been surrounded, but which were hitherto unheeded. Innumerable reports from teachers and pupils testify to the value of this new undertaking. Last June's graduating class of the Clinton School used the visit to the Garden as the theme for their graduating program. It was cleverly worked out, with a colored drawing of a view of the main Garden used to decorate the cover of the program.

On Mondays after school hours, Miss Heising offers opportunities for extra field work to a group of boys and girls living in the vicinity of the Garden.

CONSTRUCTION AND REPAIRS

A most important item of repair was the rebuilding of the roof and side frames of the floral display house. New angle irons were supplied for the frames and wood replaced where needed. In order to do away with the last of the curved glass, an additional four feet of solid roofing with the necessary shingling was built.

This permitted the use of single-length roof bars, which eliminated one of the sources of trouble experienced ever since the house was erected. The reglazing of the house, together with preliminary repairs, required about six months, using the limited amount of Garden labor available.

Because of the need for additional room in the experimental greenhouse to accommodate the amateur courses in gardening, extensive changes were necessary. The removal of the numerous partitions which divided the house into small compartments provided ample space at the west end for four new concrete benches. The heating pipes were rearranged to supply bottom heat for the propagating benches on each side.

Mention was made in the last report of the installation of a pump at the lake to supply additional water to part of the Garden not served by the city supply. It seemed desirable to abandon the temporary pipe line, and a new water line was built from old disused mains of cast-iron pipe. This main, some 2155 lineal feet in length, now supplies the iris garden and the area west of the mausoleum to the south end of the main conservatory. A test shows that over 11,000 gallons per hour may be supplied for irrigation.

A new electric-power saw was installed and the saw table rebuilt in the carpenter shop. Thirty-six shadow boxes were made for the orchids, which helped to make the display of these plants more attractive. Some idea of the multitude of minor repairs constantly required may be gained from the single fact that there are over 100 doors used by the public and employes. Shrinking and swelling of doors, door-checks, locks, springs, etc., seem to require almost constant attention.

Painting both indoors and outdoors continues to be a major item of expense and labor. During the year the following have had one or more coats of paint: floral display house, interior and exterior; pergola west of Italian garden; residences of Director and Superintendent; exterior of bromeliad and plant curiosity house; alcoves in aroid house; entrance to main conservatory; interior of waterlily house; exterior and interior of soil sheds; besides benches, drinking fountains, tree and shrub labels, etc. Nearly 7000 plant labels of copper or celluloid were machine-stamped or written by hand.

Heating Plant.—The importance of maintaining the heating department at the highest degree of efficiency is recognized. Every effort is made to insure freedom from failure at a time of year when the loss from lack of heat would be incalculable. One of the boilers was retubed and all three were scaled and cleaned. One feed pump and one vacuum pump were repaired and put in first-class working condition. Brick work and tile were renewed where necessary, and all grates and bearing bars showing weakness were replaced. The feed water lines, including pipe and valves, were rebuilt as well as the 6-inch suction line. Repairs on 14 steam traps and 320 thermostats were made with innumerable minor replacements.

OUTDOOR ACTIVITIES

It has been the custom for some years to grow a "green-manure" crop, such as soy-beans or rye, on those portions of the nursery which were not in use. Actually the practice aids in weed control, but chiefly it adds humus and maintains the fertility of the soil. Although humus might be added either as stable-manure or "green-manure," the latter method is least expensive. The usual procedure is to plant soy-beans during May or June, after it is known what portions of the area will be idle. Then in September or when the plants have attained their height, the crop is plowed under and the soil immediately prepared for the "winter-cover." This is usually rye, and it is grown until the following spring just before time to set out the nursery plants. During the past year a very heavy crop of soy-beans was plowed under. However, the rye which followed failed to make much headway until cooler and wet weather set in, too late to make its usual pre-winter growth. This field, like most all others in the eastern portion of the state, shows a light scattering of plants too small to withstand much cold without a snow cover. An effort has been made to find one or a combination of field crops which would fit into cultural methods needed for nursery work. Winter vetch has been tried for two years, and although it has proven very successful in some portions of the adjoining counties, when used in the nursery it is unsatisfactory. Usually it is very slow to grow, and even though it attains sufficient size to withstand the winter, it is unable to tolerate the continual bleaching of the city smoke. Both the annual and the biennial sweet clovers have been used. These are more expensive

than the soy-bean and rye combination, and are of value chiefly when certain ground will not be used for some time.

"Green-manuring" cannot be practiced in established shrubbery beds. About 140 cubic yards of rotted stable manure were spread over these beds and spaded under. Nine bales of peat were used to mulch the azalea beds.

During late February and early March 1800 pounds of commercial 10-8-6 fertilizer were broadcast over the lawn area. Two weeks later the lawns were raked and seeded with blue-grass and red-top. Lawn mowing began on April 22 and continued until September 29. During September additional grass seed was broadcast over the lawns.

Almost no pruning was attempted during the year, although five days were spent in removing dead trees and many more will have to be removed the coming year. No tree fertilization was done during the year. Outdoor spraying was also much restricted, only 300 gallons of arsenate of lead being used on the black walnuts. Red-spider as usual made its appearance on the Philadelphus and 300 gallons of wettable sulphur and 100 gallons of summer oil were applied as a check. Some experimental work with a wind-machine to observe the effect of a sustained blast on trees was carried on. Dendrographic studies, started in 1933, were continued and seven more instruments were placed in operation.

Hay cutting began on July 12 and required about five days to complete, exclusive of the time needed to rake, haul, and stack. While a very large crop was harvested most of it was traded for stable manure.

Leaf raking always requires a considerable portion of the late fall. This year special sides were fitted on the tractor trailer which permitted carrying much larger loads. When tightly compacted as much as 1800 pounds of dry leaves can be hauled at one time, and much less time is consumed in driving to and from the storage pile.

The compost and leaf-mold bins were filled twice during the year. A total of 280 cubic yards were hauled to these bins, shredded, and then hauled away as needed. In order that this material be always available, it must first be hauled to a pile, turned until sufficiently rotted, and then shredded into the storage bins. A considerable portion of the truck operation is devoted to this

work. Well over 12 loads per day were handled during most of the year.

The Knolls.—The work done on the knolls in the last two years was reflected by the fine display of color in the perennial borders during the year. This year numerous groups of hemerocallis and iris were transplanted and new perennials were added. It may seem odd that a city garden should still be confronted with a rabbit problem, but to lose several hundred newly planted lupine, pyrethrum, and perennial aster plants in the space of a few weeks was evidence enough that this was a good rabbit season in the Garden. Spraying the plants with arsenate of lead deterred the pests only a little. Established plants of pyrethrums were constantly nibbled, and only in late fall were the plants able to produce any foliage. Much time was spent in watering the knolls, the summer having again been a dry one.

The Linnean Garden.—This is a formal garden with numerous walks and square beds bordered on three sides by stone and brick walls and an old-style brick greenhouse, one of the few of its kind in this country. Plants of *Yucca filamentosa* are planted at the corners of all of the beds, and when these and the numerous clumps of "Miss Lingard" phlox are in bloom in mid-June it is literally a "white garden." A local newspaper called it last summer "the bride's garden." The various narcissi and the groups of *Lycoris squamigera* were removed and planted in the knoll beds. Many perennials were reset in the spring and fall.

The Rose Garden.—No climbing roses bloomed in 1936, as they had been frozen back to the ground. As if to redeem themselves this year they surpassed any previous display. The bush roses were equally good. As another dry summer set in there were but few good flowers, and even the hopes of a good autumn season were cut short by the invasion of hordes of tarnished plant bugs from September 4 to 11. These sucking insects ruined all of the buds and tender foliage. By October new buds were developing rapidly, but the early cold weather checked any further growth. Some of the very newest roses were sent here for trial and were grown in the rose garden, the nursery, and at the Arboretum. The Conard & Pyle Company of West Grove, Pa., sent 216 roses in seven varieties and the Jackson & Perkins Company of Newark,

N. Y., sent 139 plants in 16 varieties. Red spider and the tarnished plant bug were the most serious insect pests. There was some mildew but no black spot.

The Italian Garden.—All of the beds in which coleus were grown received some fresh soil in the spring, and it produced a marked improvement in the appearance of the plants. The entire garden was in excellent condition for several months. Due to the spring rains, the California privet hedge grew rapidly and required frequent clipping.

The Economic Garden.—The northern half of the economic garden is composed of three terraces, the hedge garden occupying the central section. The replanting of the hedge section was the most important change in this garden. The heavy soil on the west side of the garden and the flat terraces have created a serious drainage problem, particularly in the spring. In order to overcome this condition several lines of agricultural drain tile were laid and connected with the regular drainage system. Thirty-two beds 4 by 21 feet were prepared and planted with the following hedge plants:

Berberis mentorensis
Berberis Thunbergii
Berberis Thunbergii var. *minor*
Berberis Thunbergii pluriflora erecta
Buxus sempervirens
Caragana arborescens
Caragana aurantiaca
Carpinus Betulus
Cotoneaster acutifolia
Cotoneaster horizontalis var. *perpusilla*
Cotoneaster lucida
Crataegus Oxyacantha
Elaeagnus angustifolia
Euonymus japonicus var. *microphyllus*
Euonymus patens
Euonymus radicans var. *Carrierei*
Ligustrum Ibolium
Ligustrum obtusifolium var. *Regelianum*
Ligustrum ovalifolium
Ligustrum vulgare
Lonicera bella var. *albida*
Lonicera nitida
Lonicera Xylosteum
Physocarpus intermedius var. *parvifolius*
Physocarpus monogynus
Prunus tomentosa
Rhamnus Frangula
Salix pentandra
Syringa Josikaea
Taxus cuspidata var. *capitata*
Teucrium Chamaedrys
Thuya occidentalis
Ulmus pumila
Viburnum Lantana

The plants now growing in the hedge garden form a representative group from which to choose hedge material. The above list does not exhaust the supply of suitable hedge plants for this vicinity but has been limited by the size of the garden.

The climbing roses on the trellis surrounding the economic garden were a beautiful sight in early June. In another part of the garden a collection of dahlias and gladiolus was grown. The gladiolus were beautiful, but the dahlias suffered from the invasion of the tarnished plant bug. All missing fruit trees were replaced and trained in espalier fashion. The farm crops were successfully maintained as in previous years.

Iris and Peony Garden.—This garden was in excellent condition in May and attracted many visitors. The dwarf and intermediate iris were replanted in the fall. Only a limited number of new varieties were received through the courtesy of Mr. Samuel C. Davis and Mr. Joseph F. Wiesner.

Nursery.—Seldom is there mention of this part of the garden which is maintained for the growing of plants eventually to be used in the flower shows or in the display gardens. Each year many rows of chrysanthemum bush plants are grown in the field and later potted for the show. A great deal of work is required to care for these nurseries, in the way of watering, pinching, spraying, and weeding. Another area is devoted to the culture of trial roses or to those plants of which only one of a variety is represented. A collection of lilacs was started for propagating purposes, 45 of the leading varieties having been planted. In subsequent years the present lilac collection will be materially augmented by the addition of these new varieties.

FLORAL DISPLAYS

The schedule of the flower shows was much the same as in the previous years. On February 20 the annual orchid show was installed. For the first time shadow boxes were used to display individual groups of orchids, and this method of staging proved to be very effective.

On March 13 the azalea show was opened, followed later in the month and during April with cinerarias and other spring-blooming annuals.

Over 200 pot plants were supplied for the annual flower sermon at the Christ Church Cathedral on April 17.

On May 15 the pelargoniums were exhibited, and on May 22 and 23 the St. Louis Horticultural Society held its annual spring show.

The Veiled Prophet Queen's orchid bouquet was displayed on October 7, and this was followed by the fall dahlia show of the St Louis Horticultural Society on October 9 and 10.

In November the annual chrysanthemum show occupied the floral display house and attracted many visitors. The poinsettia show in December brought the season of floral displays to a close.

The balcony of the floral display house has always been lacking in tall background material. When the lily pool was eliminated, the pit was filled with soil and tall-growing palms were planted there. This group has already improved the appearance of this end of the house and when well established will form an excellent background for the display of odd or unusual types of flowers.

Main Conservatories and Exotic Ranges.—The collections in these houses have increased steadily since the last census was taken in 1932, and a gratifying number have flowered freely. Much plant material was used in class work, especially for taxonomic purposes, and several lots of cuttings were distributed to botanical institutions either as exchanges for other plants or as donations.

The palm house now presents a luxuriant tropical aspect, despite the fact that several large palms had to be removed because their tops began to press against the glass. Notable among these were a 35-foot *Livistona australis,* a 40-foot *Phoenix reclinata,* a 25-foot *Sabal Palmetto,* a 25-foot *Martinezia erosa,* and a 20-foot *Trachycarpus excelsus.* The ground is gradually being covered with a creeping pepper which is more satisfactory than other ground covers that have been tried. This creeper and several species of philodendron are being allowed to crawl up the trunks of the taller palms, thus presenting a naturalistic jungle effect. The exotic flora in these greenhouses was the subject of a special two-page rotogravure in one of the local newspapers.

In the cycad house can be seen several large specimens of plants with luxuriant crowns of beautiful fronds. The larger ones, such as *Dioon spinulosum, Cycas siamensis, C. revoluta, C. circinalis, C. Beddomei,* and *Encephalartos caffer,* are several hundred years old. Few visitors realize that they belong to an order which is among the most primitive of living gymnosperms and that they played an important role in the flora of prehistoric times. The curtain vine (Cissus), another conspicuous feature in the house, was severely pruned, this being necessary every third year.

In the banana-coffee finca the plants have again attained their former vigor, due to the heavy application of fertilizers, frequent ground culture, and a heavy dosage of water. The scarlet wax-mallow *(Malvaviscus grandiflorus)* is a conspicuous feature among the bananas and coffee plants and has proven an outstanding winter and spring bloomer during the past year. The crimson-lake *Bougainvillea, Agdestis clematidea,* and *Clerodendron Thomp-sonae* have produced luxurious growth and an abundance of flowers.

Several minor changes have been made in the aroid and bromeliad houses, while the collection in the plant curiosity house has been thoroughly revamped. The plant life represented here is unusual and arouses the interest of school children particularly. Among the outstanding living curios are the sensitive plants, tank air-plants, and insect-eating plants. The flame-of-the-woods, or *Ixora coccinea,* with its dense clusters of delicate orange to red flowers, was planted among the various aroids and brightened up the collection during the summer season. Another handsome evergreen bush, *Rondeletia leucophylla,* was found very suitable in interspersed plantings. This blooms profusely with dense bunches of pink flowers, and many cuttings were made for pot culture.

The succulent collection has grown steadily from year to year, and at present contains 1,082 species. There are 445 cacti distributed among 69 genera; 182 species of succulent lilies; 100 euphorbias; 99 stapeliads; 85 mesembryanthemums; 67 succulent amaryllids; 58 crassulaceous plants, and 46 miscellaneous desert plants. The Selenicerei and other night-blooming climbing cacti have been installed upon new trellises and their growth has extended to the roof. On one night (July 1) 45 big waxy fragrant blooms appeared from the green snake-like stems of two mooncereus. Each flower was about 12 inches long and about 6 inches broad when fully opened.

EXPERIMENTAL GREENHOUSES

This small range, in addition to providing space for the regular courses in elementary and advanced gardening, is devoted primarily to investigations requiring special technique not easily carried on in the regular propagating and growing houses. Nearly a thousand varieties of seed were tested during the year, many of

which came to nothing. The breeding of geraniums was continued. Of the 1700 seedlings grown last year, 24 have been selected for their outstanding qualities and for further hybridizing. Some 800 seedling geraniums are now being raised from which additional selections will be made. The breeding of penstemons continues.

Other projects receiving attention at this time include: experiments with orchid seed germination, preservation of cut flowers, effect of various growth-substances on root formation, hardiness of gladiolus, endurance test on a wide assortment of plant labels, and several minor problems.

RESEARCH AND INSTRUCTION

The only change in the staff is that involving changes in title. Dr. Edgar Anderson was appointed Engelmann Professor of Botany in the Henry Shaw School of Botany, in charge of Botany, Washington University. This professorship was formerly held by Dr. George T. Moore. Dr. Moore was appointed Director of the Henry Shaw School of Botany, a new position.

Dr. J. M. Greenman, Curator of the Herbarium and Professor in the Henry Shaw School of Botany of Washington University, as in previous years, has devoted most of the time to curatorial work of the herbarium. In addition to these exacting duties, he has directed the work of graduate students in taxonomy and has given advanced courses in comparative morphology and taxonomy of vascular plants and in plant geography in the Shaw School of Botany. The large enrollment in the advanced course, scheduled in the Washington University Catalogue of the School of Graduate Studies as "Botany 460 (formerly 60). Morphology and Taxonomy of Angiosperms," continues to tax the capacity of the laboratory space and equipment of the Missouri Botanical Garden.

Dr. Greenman has also continued research work on special taxonomic problems on which he has been engaged for several years. These investigations include monographic studies in the Compositae, particularly on the genus Senecio, and in various other groups of plants of western United States, Mexico, Central and South America. Preparation of manuscript for a "Flora of the Southwest" is still going forward.

Dr. C. W. Dodge, Mycologist to the Garden and Professor in the Henry Shaw School of Botany of Washington University, as-

sisted by Dr. Gladys E. Baker of Hunter College, has completed a study of the lichens and fungi of the Second Byrd Antarctic Expedition. Many new endemic species have been recorded from Marie Byrd Land and King Edward VII Land, with a few from the Queen Maude Range of South Victoria Land. In connection with this study, the collections of the Borchgrevink Expedition from South Victoria Land in the botanical museums of Upsala and Oslo have been revised. Mr. Paul Siple, botanist of the Byrd Expedition, has prepared the ecological and geological portion of the report.

The second part of the "Foliose and Fruticose Lichens of Costa Rica," containing Stictaceae and Peltigeraceae, is nearing completion. This has necessitated a study of much tropical American material, including a revision of all the Stictaceae of the C. C. Plitt Herbarium, mostly from Jamaica, as well as a large series of specimens from the Thomas Taylor Herbarium and the U. S. National Herbarium. The abundant collections of Stictaceae by the late R. Thaxter from Chile, as well as smaller collections from several correspondents in Chile, have also been studied. Routine determination of several hundred specimens has been accomplished due to assistance by Mr. U. L. Dubois in the preparation of microscopic slides. In connection with his study of cephalodia, Mr. G. T. Johnson has determined a large series of specimens of Stereocaulon from Japan and a somewhat smaller series from New Zealand which have been awaiting study for a long time. Mr. D. F. Flint has aided in clerical work and in the insertion of specimens in the lichen and fungus herbaria.

Under a grant from the International Cancer Research Foundation, a study of the action of methyl cholanthrene on various groups of yeasts has been undertaken, resulting in a preliminary report published recently. Further work is being undertaken.

Miss Helen Bramsch, M.S., resigned the assistantship during the summer to accept a fellowship at the University of California, and Mr. Stanley Hagen, B.S. (University of Oklahoma) began his duties as research assistant on October 1.

The usual courses of instruction have been given and research of students supervised. With Mr. G. T. Johnson and Mr. A. C. Jones a study of heterothallism and the physiology of a new species of Coprinus is progressing rapidly. This species isolated in

Costa Rica in 1936 is very well adapted to laboratory study. Some work has also been undertaken on a new disease of the banana also isolated and studied in the field in Costa Rica in 1936. Mr. Ralph Hervey, B.S., accepted a fellowship at the Oceanographic Institution at Woods Hole and is continuing his study of Thiobacillus under Dr. S. A. Waksman.

Dr. Edgar Anderson, Geneticist to the Garden and Engelmann Professor in the Henry Shaw School of Botany, has continued to center his research about the species problem. Intensive work on the genus Tradescantia has been balanced by extensive studies on the flora of the wild-flower gardens at the Arboretum. A grant from the Science Research Fund of Washington University made it possible to study Tradescantia in southern Texas for ten days in late March.

This year Professor Anderson has continued in charge of the seminars for graduate students in botany, as well as assuming his new duties in connection with the Henry Shaw School of Botany. In October he offered a course for amateurs in University College on the identification of garden plants, which met with a most encouraging response.

Dr. E. S. Reynolds, Physiologist to the Garden and Associate Professor in the Henry Shaw School of Botany, has continued his studies on the effects of various environmental factors on the growth of plants in the laboratory and greenhouse. Special attention was given to temperature, light, and accessory growth substances. The inter-relations of the internal temperature of plants with other physiological factors are being studied. Experiments on the digestion and translocation of foods, with certain associated physical problems, have been initiated, looking towards a better understanding of these processes. The usual courses in introductory and advanced physiology and the supervision of the work of graduate students in plant physiology have been continued.

Dr. Robert E. Woodson, Jr., Research Assistant to the Garden and Assistant Professor in the Henry Shaw School of Botany of Washington University, has, as in previous years, carried on research in the taxonomy of the family Apocynaceae. The sections concerning that family have been completed for *The North American Flora* (published serially by the New York Botanical Garden) and the miscellaneous papers on the flora of the Yucatan

Peninsula (published jointly by the University of Michigan and the Carnegie Institution of Washington). His study of the floral anatomy of the Apocynaceae has also been brought to a close, and is now in press (to appear in the *Bulletin of the Torrey Botanical Club*). During the ensuing year he plans to commence the taxonomic study of the tribe Tabernaemontaneae of Apocynaceae as represented in America, a tribe of importance in the forest flora of tropical America.

During the months of July, August, and September, Dr. Woodson collected in Panama in company with Mr. Paul H. Allen, Manager of the Tropical Station, Professor G. W. Martin, of the State University of Iowa, and Mr. R. J. Seibert, Assistant in Botany at Washington University. Many localities of great interest were visited, and approximately 5,000 herbarium specimens obtained. The greater part of the specimens were lost, however, in a fire which occurred in the building of the Station shortly before the party was to return to the States. The party hopes to return to Panama during the summer of 1938.

As in previous years, the greater part of Dr. Woodson's time during the academic year has been devoted to class work in the Henry Shaw School of Botany of Washington University, where classes in Elementary Plant Biology, General Morphology and Taxonomy, Plant Anatomy, and Microtechnique have been offered. It is a great satisfaction to note the improvement in scholarship of students attending these courses despite somewhat diminished numbers.

Graduates and Fellows.—The following appointments were made in the Henry Shaw School of Botany for the year 1937-1938.

Assistants in Botany: (research assistant) Stanley H. Hagen, B.S., University of Oklahoma; (half-time assistants) Russell J. Seibert, A.B., Washington University (Taxonomy and Morphology); Hugh Carson Cutler, B.A. and M.A., University of Wisconsin (Taxonomy).

Washington University Fellowships: George Thomas Johnson, B. A., University of Arkansas (Mycology and Taxonomy); Francis Marion Ownbey, B.A. and M.A., University of Wyoming (Taxonomy).

Jessie R. Barr Fellowship: Ruth E. Peck, A.B., Grinnell College, M.S., Washington University (Cytology and Taxonomy).

Washington University Van Blarcom Scholarship: Elizabeth Ammerman, A. B., Washington University.

Special Research Fellowship, American Creosoting Company: Hereford Garland, B.S. and M.S., University of California (Physiology, Taxonomy, and Anatomy).

Washington University Scholar: Mary Goddard, B.E., Illinois State Normal College, M.S., University of Michigan (Mycology and Taxonomy).

Independent Student: William L. Brown, A.B., Bridgewater College, Bridgewater, Va. (Cytology and Taxonomy).

Degrees.—The following students in the Henry Shaw School of Botany received advanced degrees at the Washington University commencement in June: Fred Alexander Barkley (Taxonomy and Physiology) and George Bippus Happ (Taxonomy and Morphology), Doctor of Philosophy; Henry N. Andrews (Morphology and Taxonomy) and Ruth E. Peck (Cytology and Taxonomy), Master of Science.

Apprenticeships.—No new apprentices were appointed in 1937. Francis C. Harris and Arthur B. Hoffman are pursuing their third and last year of apprenticeship, and Karl E. Busch was relieved to accept a position at Iowa State College.

Published Articles.—

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Scientific and Popular Lectures.—

Dr. Edgar Anderson, Geneticist to the Garden: January 17, the International Institute, "Plant Collecting in the Balkans"; February 11, Garden Club of Des Moines, Iowa, "Unusual City Gardens," and February 12, the flower arrangement group of the Club, "The Beauty of Botany and the Botany of Beauty"; February 23, zoology seminar of Washington University, "Morphological Evidence of Gene Action in *Primula sinensis*"; February 24, Students' Forum at the Washington University Art School, "Balkan Contrasts"; March 10, Vandeventer Place Garden Club, "Unusual City Gardens"; April 23, biology section Missouri Academy of Science, "Hybridization Studies on the Tradescantia

of Missouri"; April 24, at the luncheon of the Junior Academy of Science of the Academy of Science of St. Louis, "Adventures with Plants"; May 19, horticultural committee of the Garden Club of America, "The Missouri Botanical Garden"; June 22, North Shore Garden Club, Glencoe, Ill., June 25, Lake Forest Garden Club, Lake Forest, Ill., July 15, Lake Minnetonka Garden Club, Wayzata, Minn., June 26, Schoolcraft Garden Club, Schoolcraft, Mich., "The North American Climate and the American Garden"; November 18, ladies attending the convention of the American Institute of Chemical Engineers, "Henry Shaw and His Garden"; December 29, at Indianapolis, systematic section Botanical Society of America, "Survey of Modern Opinion in Regard to Genera," in the symposium "The Concept of the Genus."

Mr. A. P. Beilmann, Arboriculturist to the Garden: March 16, Greater St. Louis Association of Gardeners, "Tree Feeding"; August 6, Optimists Club of St. Louis, August 19, Maplewood Optimists Club, September 23, Rotary Club of St. Louis, October 12, St. Louis Hills Garden Club, October 22, Rotary Club of Rolla, Mo., "The Tree as a Living Organism"; December 7, Greater St. Louis Association of Gardeners, "Garden Pests"; December 8, Inspirational Club, "Trees."

Mr. Ladislaus Cutak, in charge of Succulents at the Garden: July 21, Dolly Madison Garden Club, at Woodberry Forest, Virginia, "The Practical Culture of Succulent Plants."

Dr. Carroll W. Dodge, Mycologist to the Garden: December 29, at Indianapolis, Mycological Society of America, "Some Effects of Methyl Cholanthrene on Yeasts"; December 30, at Indianapolis, Sullivant Moss Society, "The Plants of the Second Byrd Antarctic Expedition."

Dr. J. M. Greenman, Curator of the Herbarium: April 23, biology section, Missouri Academy of Science, "Noteworthy Collections in the Herbarium of the Missouri Botanical Garden"; October 28, Academy of Science of St. Louis, "The Herbarium of the Missouri Botanical Garden"; December 28, at Indianapolis, joint session with Botanical Society of Amercia, American Phytopathological Society, American Society of Plant Physiologists, Mycological Society of America, American Fern Society, and Sullivant Moss Society, "Taxonomy as a Field for Research,"

address of the retiring vice-president for Section G, A. A. A. S.; December 29, systematic section, Botanical Society of America, "Genera From the Standpoint of Morphology," in the symposium, "The Concept of the Genus."

Mr. L. P. Jensen, Manager of the Garden Arboretum: February 1, Garden Club of Gray Summit, Mo., "1937 Novelties of Annuals and Perennials"; April 5, Garden Club of Gray Summit, Mo., "Notable Private Gardens of St. Louis and Vicinity"; May 5, Convention of the Missouri State Federation of Garden Clubs, at Cape Girardeau, Mo., and May 10, Garden Club of Gray Summit, Mo., "Roadside Planting and Improvement"; August 4, Sedalia Garden Club, Sedalia, Mo., "Roadside Rest-a-way Grounds and Roadside Planting"; September 29, convention of American Institute of Parkway Executives, at Fort Worth, Texas, "Parkway and Roadside Planting"; November 1, Garden Club of Gray Summit, Mo., "Berry-Bearing Trees and Shrubs for Ornamental Planting"; November 30, members of the Henry Shaw Gardenway Association, at Peck's Farm, Allenton, Mo., "Roadside Development"; December 6, Garden Club of Gray Summit. Mo., "History of Landscape Gardening."

Mr. Paul A. Kohl, Floriculturist to the Garden: February 5, meeting of the St. Louis Horticultural Society, "Garden Experiences of 1936."

Dr. George T. Moore, Director of the Garden: January 5, College Club of St. Louis, and February 1, Unity Club of the Church of the Unity, "Henry Shaw and His Garden"; April 6, students of Harris Teachers College, "The Early Days of the Garden"; April 7, students in botany at Washington University, "Botany and Business"; May 6, at a banquet of the Business and Professional Women's Class of the Third Baptist Church, "The Man Who Has Brought the Greatest Renown to St. Louis"; May 7, the St. Louis Horticultural Society, "The Missouri Botanical Garden"; May 25, Harris Teachers College, "Henry Shaw and His Garden"; June 16, the commencement address of the Sherman School; November 11, Women's Council of the Union Avenue Christian Church, "Henry Shaw and His Garden"; December 17, history of science section of the Academy of Science of St. Louis, "Some Fifteenth, Sixteenth, and Seventeenth Century Contributions to the History of Botany."

Mr. George H. Pring, Superintendent of the Garden: January 20, Natural History Society of Panama, Balboa, C. Z., "The Missouri Botanical Garden Throughout the Year"; January 21, Panama Orchid Society, Balboa, C. Z., "The Development of the Orchid from Seed to Flower"; January 21, the College Club, Balboa, C. Z., "The Pollination of the Orchid"; January 28, Balboa Junior College, Balboa, C. Z., "The Missouri Botanical Garden Throughout the Year"; January 29, the Rotary Club of Panama, Balboa, C. Z., "Keeping the Tropics in St. Louis"; March 1, Garden Club of Gray Summit, Mo., March 3, State Highway Department School, Sedalia, Mo., March 5, St. Louis Horticultural Society, March 11, St. Louis Florist Club, March 16, St. Louis Garden Club, "The Bellingrath Azalea and Camellia Gardens"; March 15, Kiwanis Club of Normandy, "Spring Flowers"; March 18, Girl Scouts, "Identification of Native Plants"; April 7, Publicity committee of the Kiwanis Club, "The City Garden Contest"; April 9, at the Arbor Day planting, under the auspices of the North Side Business Men's Association, "The Value of a Tree to a Community"; April 13, Young Men's Sodality of St. John the Baptist Church, "Plant Exploration"; April 20, Kiwanis Club of University City, "The Romance of the Flowers"; April 21, Phi Sigma Biological Society of Washington University, "Plant Exploration in Central and South America"; May 19, Kirkwood Rotary Club, "Jungle Experiences in Panama"; May 27, Alhambra Grotto, "Orchid Exploration in the Andes"; June 15, graduates of the Shaw School, "Henry Shaw"; June 30, Missouri State Florists convention, at Hotel Chase, and July 2, the St. Louis Horticultural Society, "Experiments with Hormodin"; November 15, Rowena Clarke Garden Club of Kirkwood, Mo., "The Development of the Chrysanthemum Flower"; December 8, Laymen's League of St. John's Episcopal Church, "Curiosities in the Garden"; December 14, Clifton Heights Men's Club, "Romance of the Plant World."

Dr. Hermann von Schrenk, Pathologist to the Garden: January 26, meeting of American Wood Preservers' Association, at New Orleans, "Toxicity of Oils Extracted from Old Timbers"; December 10, coal operators at Prenter, West Virginia, "Mine Timber Preservation"; December 14, society of Sigma Xi, Missouri School of Mines, Rolla, Mo., "Timber Research."

HERBARIUM

The herbarium has had a satisfactory year. Substantial additions have been made to its representation of the world's flora. Many important collections have been acquired, but the greatest increase has been from the western and southwestern United States, Mexico, Central America, and South America.

New Accessions.—The more noteworthy acquisitions during the year are the following: P. Aellen, 425 plants of Corsica and Syria; Paul Allen, 150 plants of Panama; Edgar Anderson, 139 plants of Michigan, Missouri, Texas, and also from horticulture; Fred A. Barkley, 128 plants of Iowa, Oklahoma, Missouri, and also 68 photostats of *Rhus;* A. P. Beilmann, 65 plants of horticulture; Edward C. Berry, 122 lichens of Iowa and Missouri; California Academy of Sciences, 118 plants of California; Cornell University by K. M. Wiegand, 861 plants of the United States; Al. Cretzoiu, 500 plants of Dobrogea and Banat; Hugh C. Cutler, 97 plants of Texas, and 16 plants of Michigan; Otto Degener, 195 plants of Hawaii; Delzie Demaree, 750 plants of Arkansas, Oklahoma, and Texas; J. A. Drushel, 76 plants of New Jersey and New York; C. F. E. Erichsen, 200 lichens of Germany; Walter J. Eyerdam, 100 mosses of the Aleutian and Kodiak Islands; Field Museum of Natural History, 500 plants chiefly from North America; George D. Fuller, 1,000 plants of Illinois and Colorado; Howard Scott Gentry, 520 plants of Mexico; F. A. Gilbert, 106 plants of West Virginia; George J. Goodman, 356 plants of Oklahoma and Texas; E. H. Graham, 520 plants of the Uinta Basin, Utah; C. Grandjot, 500 plants of Chile; Gray Herbarium of Harvard University, 47 plants of Brazil; J. Linsley Gressitt, 488 plants of southeastern China; Roland Harper, 50 plants of Alabama; Botanical Museum of Harvard University, 173 orchids chiefly from the Philippine Islands; F. J. Hermann, 274 plants of Michigan; G. Herter, 145 plants of Uruguay; George B. Hinton, 200 plants of Mexico; Leslie Hubricht, 680 plants of Missouri and the Great Smoky Mountains National Park; John H. Kellogg, 172 plants of Missouri and Arkansas; Ellsworth P. Killip, 225 plants of Peru, collected by G. Klug; B. A. Krukoff, 1,128 plants of Brazil; Maude C. Lodewyks, 61 plants of Missouri and Illinois; E. Lyonnet, 500 plants of Mexico; Mrs. Ynes Mexia, 515 plants

of South America; Harold N. Moldenke, 65 photographs of types and authentic specimens of the Verbenaceae; P. A. Munz, 220 photographs of type specimens of *Astragalus, Oenothera,* and *Gaura;* Norodin Museum, Prague, 51 fungi of Czechoslovakia; National Research Institute of Biology, Nanking, China, 785 fungi of China; Aven Nelson, 560 plants of Arizona; New York Botanical Garden, 565 plants of Florida and Mexico, and 39 photographs of types; New York State College of Forestry by H. P. Brown, 1,200 plants of British India, Cochin China, Rhodesia, etc.; Marion Ownbey, 136 plants of Wyoming, Colorado, and Nebraska; Philadelphia Academy of Natural Sciences, 676 plants chiefly of eastern North America; Edith A. Purer, 77 plants of California and Lower California; Reed C. Rollins, 400 plants of Washington and Idaho; Heinrich J. F. Schimpff, 71 plants of Ecuador and the Galapagos Islands; Russell J. Seibert, 70 plants of Panama; Forrest Shreve, 178 plants of Lower California; Alexander F. Skutch, 459 plants of Costa Rica; Paul C. Standley, 550 plants of Brazil, collected by Adolpho Ducke; State College of Iowa by G. W. Martin, 80 plants of Panama and Colombia; State College of Washington, 184 plants of northwestern United States; Mrs. Julian A. Steyermark, about 1,000 plants of Missouri; Julian A. Steyermark, 6,177 plants mostly from Missouri; James Stokes, 49 ferns of Georgia; H. Sydow, 200 fungi; J. William Thompson, 1,288 plants of Washington and Oregon; U. S. National Museum, 232 plants mostly from Virginia and South America; University of California, 863 plants of South America; University of Helsingfors, 150 plants of Finland; University of Jagellonica, 200 plants of Poland; University of Michigan, 37 plants of British Honduras and Guatemala; University of Montana, 100 plants of Montana; University of Oklahoma, 87 plants of Oklahoma and New Mexico; University of Pennsylvania, 180 plants of New Jersey; Utah State Agricultural College, 156 plants of Utah; Hermann von Schrenk, 204 plants of Missouri, Colorado, and Texas; Trifon von Schrenk, 105 plants of Europe, from the private herbarium of the late Roland La Garde; Th. Oswald Weigel, 404 plants of Taiwan, Formosa, Europe, Mexico, and Bolivia; Louis E. Wheeler, 300 plants of California; Louis O. Williams, 586 plants of Montana and Wyoming; R. E. Woodson, Jr., 642 plants mostly from Costa Rica; T. G. Yuncker, 750 plants of British Honduras.

In addition to the above there have been many smaller accessions which have been duly recorded in current numbers of the Garden Bulletin.

Mounting and Insertion of Specimens.—The mounting and insertion of newly acquired material has continued throughout the year. The number of specimens added to the permanent collections amounts to about 14,000 or approximately one-half the total number of specimens acquired in this period.

Many plants installed in the herbarium during previous years have been thoroughly rearranged in the light of published revisions, monographs, and current literature. Scientific names have also been brought in accord with present International Rules of Botanical Nomenclature. Among the groups which have received particular attention during the past year are the lichens, several families of flowering plants, and also of mosses. Much time has been devoted to this important work which greatly enhances the value of the herbarium for reference and comparative studies.

Exchanges.—The exchange of duplicate herbarium specimens, a very essential feature in the growth and development of every progressive herbarium, has continued. During the year 1937, the Missouri Botanical Garden Herbarium has received through exchanges 8,828 specimens; and during the same period 2,618 duplicate specimens have been sent to correspondents.

Field Work.—A limited amount of field work has been carried on by members of the staff and graduate students. Large collections of Missouri plants have been acquired during the year, notably the one obtained from Dr. Julian A. Steyermark, a former student in the Shaw School of Botany. This collection of over 6,000 specimens of Missouri plants is of particular interest in establishing new records and also in determining more accurately the geographical distribution of species and varieties within the borders of the state.

The liberality and loyalty on the part of past and present students of the Henry Shaw School of Botany have continued to be important factors in building up the herbarium.

Use of the Herbarium.—It is gratifying to record again the increased use of the herbarium, especially by visiting botanists from different parts of this country and from foreign countries.

Furthermore, the amount of herbarium material loaned to institutions for study by specialists is likewise on the increase. Although the temporary withdrawal of specimens from the herbarium and the time necessary to keep accurate records in connection with loans, as well as the reinserting of specimens on their return, involves considerable time, yet the scientific value of our specimens is thereby greatly enhanced; hence, the advantage gained by borrower and lender is mutually shared.

Statistical Summary (for the year ending December 31, 1937):

Number of specimens acquired on new accessions:

By purchase	16,415	
By gift	6,516	
By exchange	8,828	
By transfer	68	
By field work	436	
Total	32,263	
Number of specimens mounted and incorporated in 1937		14,001
Number of specimens received in 1937, still unmounted		18.262
Number of specimens in unorganized herbarium, carried forward from 1936		124,937
Number of specimens in organized herbarium, carried forward from 1936		1,097,472
		1,254,672
Number of specimens discarded in 1937		31
Total number of specimens in herbarium		1,254,641

LIBRARY AND PUBLICATIONS

If this report merely emphasized the growth of the library and the routine duties of the staff, it would be a mass of statistics and would give no idea of what really goes in this branch of the Garden. That the librarians care for books, order more, and keep them available to botanists and gardeners is taken for granted, but the contacts with the public, brought about by the use of a very unusual and well-equipped reference library, is a matter of which few people have any knowledge. Not a day passes but what there are information calls, such as "What is primavera mahogany?"; "Where does marahuana naturally grow?"; "Where can I get information about growth hormones?" or "of water cultures?" One of the librarians at the Garden has a book in which she enters ref-

erences to timely subjects as they appear in magazines; then when the inquiries come, and they come in waves, she has the information right at hand. Of the visitors, some drop in, get the desired information, and are gone in a moment. Others come for a day or two and call into play all the resources of the Garden, including the librarians and staff. For instance, a doctor had a florist patient who was evidently allergic to something with which he constantly came in contact. "Could it be baby-breath?" he asked. So the librarians checked up on the botany of the plant, the family to which it belonged, lists of allergy plants, and attempted to give him the desired information. Another visitor was an artist who wished an illustration of Plumeria (frangipani) for a wall-paper design. Then there were two mail clerks who have botany for an avocation and have graduated themselves from Liverworts to Mosses. One library consultant was planning to install at a fair an exhibit of plants mentioned in the Bible and Shakespeare. She wanted her information accurate and complete, and she spent a week with us.

An extra-routine library achievement which attracted much comment were the three book exhibits arranged for the members of the Garden Club of America, when they met in St. Louis in May. Some of the Garden collections best exemplifying flower illustration were sent to the City Art Museum to supplement such an exhibit held there for this occasion. Another collection shown in the folio room was prepared by Dr. Anderson to show the history of botanical illustration, a BULLETIN article on the subject accompanying the exhibit. Then there was a display in the old lecture room of herbals and early botanical books, of which five are incunabula (books printed before 1500). These last two exhibits were held over for a week, until the visit of the botany classes from the University of Missouri.

All of the above is in addition to the regular library routine. Of this the biggest job was moving the books from the crowded serial section to the old lecture room. The first step was to close up the extra space in the lecture room to make space for the serials, and this necessitated moving every publication in the sections on Plant Geography, Floras of the World, Systematic Botany, etc. While this is being done all the books and pamphlets in the room are being cleaned and relabeled when necessary. Only about one-half

of the 40,000 have been moved so far, but the work will be completed before next year, and then the serials can be moved. All the books in the folio room, which represent the most valuable part of the library, were gone over by a leather specialist, being cleaned, oiled, and repaired when needed.

A check-list of reports of congresses made us realize a deficiency in the Garden library system. Such publications had been classified and shelved under the country of meeting, and were very much scattered. The reports of the International Botanical Congress, for instance, were found in eight different sections and in four different languages. All the congress reports have now been assembled in one section, with cross-references where necessary, and are easily available.

New Accessions.—While no special collections were purchased during the year, the library has taken advantage of the works advertised in botanical catalogues to acquire a number of rarities, some of which had been on the *desiderata* list for years. Among these worthy of special mention are the following:

Moench, C., "Methodus plantas horti botanici et agri Marburgensis a staminum situ describendi," a work published in 1794, in which a number of plant novelties were described. We were told several years ago that this work would be nearly impossible to find.

"Synopsis of the genera of American plants according to the latest improvements on the Linnaean system." 1814. This book is very rare, and is not listed either in Pritzel's "Thesaurus" or Jackson's "Guide to the literature of botany."

Houstoun, G., "Reliquiae Houstounianae seu plantarum in America meridionali a Guil. Houstoun, collectarum icones. . . ." 1781. This is another rare publication which the Garden was fortunate to obtain.

Two works of C. S. Rafinesque: "Autikon botanikon," parts 2–3, centuries 6–15. We already had part 1 of this, so now the work is complete; "New flora of North America," pt. III. "New Sylva," and pt. IV. "Neobotanon." The acquisition of these two pamphlets has helped in making our Rafinesquiana complete as far as botany is concerned.

Palisot-Beauvois, A. M. F. J., "Flore d'Oware et de Benin, en Afrique." 1805–1818. Dr. E. D. Merrill, of the Arnold Arboretum, has a full account of this author in the "Proceedings Amer-

ican Philosophical Society," entitled "Palisot de Beauvois as an overlooked American botanist." According to Merrill, complete sets of this publication are so rare that an English bookdealer listed a copy with colored plates at 180 pounds, stating that it was the only complete copy he had ever had. Unfortunately the Garden copy is not so valuable as that, for it is without colored plates and apparently lacks several pages and plates, but it is a bibliographical "find" nevertheless.

[Roupell, Mrs. A. E.] "Specimens of the Flora of South Africa. By a Lady." A very interesting book containing plates of original drawings made from specimens collected at the Cape of Good Hope during a temporary residence in that Colony. Dr. Wallich and Sir William Hooker approved the plates, and Professor Harvey of Dublin contributed the descriptive remarks.

Cooke, M. C. "Supplementary illustrations of British fungi discovered in Britain since Cooke's illustrations." The plates are hand-drawn and colored, and are recorded in W. G. Smith's "Synopsis Agaricenae."

Other important accessions were the following:

Afzelius, A., Genera plantarum Guineensium revisa et aucta. 1804; Briquet, J., Prodrome de la Flore Corse. vol. 2. 1913–36; Brondeau, L., Recueil de plantes cryptogames de l'Agenais. 1828–1830; Carisso, L. W., Conspectus florae Angolensis; Chase, A., First book of grasses. 1st edition. 1922; Christensen, C., Den Danske Botaniks Historie Med. Bibliographi. 1912–26; Engler, A., Das Pflanzenreich. Heft. 102; Evans, I. P., Flowering plants of South Africa. vol. 17, nos. 65–68; Fortschritte der Botanik, vols. 1–6. 1923–37, and continuation; Grove, A., Supplement to Elwes' Monograph of the genus Lilium, pt. V; Hooker, J. D., Handbook of the New Zealand flora. 1864–1867; Hutchinson, J. & J. M. Dalziel, The flora of West-tropical Africa; and Useful plants of West-tropical Africa; Institut des Parcs Nationaux du Conge Belge, Aspects de végétation des parcs nationaux du Conge Belge 1[1], and continuation; Jepson, W., Flora of California, vol. 2, pt. 1; Kollmann, F., Technologie des Holzes; Komarov, V. L., Flora U. R. S. S.; Koorders-Schumacher, Exkursion Flora von Java, vol. 4; atlas 7, abt. 2; Ledebour, C. F., Flora Altaica, vols. 1–4 and supplement. 1829–33; Meneghini, J., Monographia Nostochinarum Icarum. 1842; Motyka, J., Monographie

der Gattung Usnea; Nakai, T. & M. Kitagowa, Report First Scientific Expedition to Manchoukuo. Plantae novae Jeholensis, sect. IV, pts. III & IV; Oppenheimer, C., Die Fermente. Supplement; Parey's Blumengartnerei. Vols. 1–2. 1931–32; Reid, E. M. & M. E. J. Chandler, London clay flora. 1933; Rabenhorst, L., Kryptogamen-flora von Deutschland, Band IX, Abt. 1, Teil 2, Lief. 2 and 3; Bravo de Robles, H., Las Cactaceas de Mexico; Sorauer, P., Handbuch der Pflanzenkrankheiten, Pflanzenschutz, vol. 6, pt. 1; Stahl, A., Flora de Puerto Rico, 2nd. ed. vols. 1–3; Troll, W., Vergleichende Morphologie der höheren Pflanzen. I, Teil I, Lief. 2–3; Vajda, E., Flora Phytographica Hungariae, vol. 2, pts. 14–15, vol. 3, pts. 1–5; Velenosky, Ceske Houby. 1922.

Garden Publications.—Volume XXIV of the quarterly ANNALS was issued during the year. The volume consists of twelve papers by members of the staff and students, and contains 598 pages and 34 plates. In addition to this volume the first number of Volume XXV (February, 1938) was completed in December. The number comprises seven papers by Dr. Greenman's former students, and the reprints were bound as an anniversary volume and presented to Dr. Greenman on his seventieth birthday, December 27.

The BULLETIN was issued monthly except July and August, the 1937 volume containing 185 pages and 26 plates. In January, 1937, the BULLETIN list was revised and the publication is now being sent only to subscribers or to those sending publications in exchange. This change in status made it possible to have the BULLETIN entered in the post-office as second-class mailing matter which effects quite a saving in postage. The preparation and proofreading of these publications is done by the Librarian.

There are now 287 persons and institutions subscribing to the BULLETIN and 120 sending publications in exchange. There are 424 foreign and 126 domestic institutions exchanging with the ANNALS, seven of which were added during the year: from Brazil, China, Ecuador, Manchoukuo, Palestine, U. S. S. R., and Spain. It is estimated that about 800 publications are received annually in exchange for the ANNALS. In August the usual number of ANNALS reprints were mailed out to about 250 botanists in this country and abroad, many worth-while publications being received in exchange for these. The ANNALS is also sent on subscription.

The cash receipts during the year from all Garden publications was $2,319.62.

Use of the Library.—In addition to the staff and students in the Henry Shaw School of Botany and the Garden, the following out-of-town botanists and horticulturists have consulted the library during the year: Miss Esther Adams, Teacher of Biological Sciences, Moberly Junior College, Moberly, Mo.; Dr. Caroline Allen, Assistant in the Herbarium, Arnold Arboretum of Harvard University, Jamaica Plain, Mass.; Dr. Priscilla Avery, of the Department of Botany, University of California, Berkeley; Mr. J. M. Batchelor, Associate Soil Conservationist, Division of Research, U. S. Department of Agriculture, Washington, D. C.; Mr. Edward C. Berry, Instructor in Biology, Central Missouri State Teachers College, Warrensburg, Mo.; Mr. M. E. Campbell, Senior Cotton Technologist, Bureau of Agricultural Economics, Washington, D. C.; Prof. J. A. Clark, Professor of Biological Sciences, Hannibal-La Grange College, Hannibal, Mo.; Mr. Ira W. Clokey, of Los Angeles, Calif.; Mr. Charles J. Collins, Exchange Student from the Royal Botanic Gardens, Kew, England; Mr. D. S. Correll, of the botany department, Duke University, Durham, N. C.; Mr. Constantine Coukas, Junior Agronomist, U. S. Dept. of Agriculture, Soil Conservation Nursery, Elsberry, Mo.; Dr. Delzie Demaree, Head of Science Division, A. & M. College, Montecello, Ark.; Dr. O. J. Eigsti, Head of the Department of Biology, Greenville College, Greenville, Ill.; Dr. W. H. Emig, Assistant Professor of Botany, University of Pittsburgh; Dr. Carl Epling, Associate Professor of Botany, University of California, Los Angeles; Mr. Edgar L. Evinger, Associate Soil Conservationist, Division of Research, U. S. Department of Agriculture, Washington, D. C.; Mr. J. A. Ewan, Instructor in Biology, University of Colorado, Boulder; Dr. Norman C. Fassett, Assistant Professor of Botany, University of Wisconsin, Madison; Mr. F. R. Fosberg, fellow at the Morris Arboretum, University of Pennsylvania, Philadelphia; Dr. Harry J. Fuller, Associate in Botany, University of Illinois, Urbana; Dr. I. A. Gamble, of Washington, D. C., member of the Rosarium Committee; Mr. L. F. Gerdes, Cotton Technologist, Bureau of Agricultural Economics, Stoneville, Miss.; Dr. George J. Goodman, Assistant Professor of Botany, Iowa State College, Ames; Dr. C. L. Hitchcock, Assistant Professor of Bot-

any, University of Washington, Seattle; Dr. Alexander Hollaender, of the Department of Botany, University of Wisconsin, Madison; Dr. Clarence E. Kobuski, Assistant Curator of the Herbarium, Arnold Arboretum of Harvard University, Jamaica Plain, Mass.; Mr. Ralph Kriebel, of the Soil Conservation Service; Mr. C. L. Lundell, of the University of Michigan, Ann Arbor; Dr. D. T. MacDougal, of Carmel, California; Dr. and Mrs. Harry D. MacGinitie, of the Department of Biology and Geology, Humboldt State College, Arcata, Calif.; Dr. F. P. McWhorter, Professor of Plant Pathology, Oregon Agricultural College, Corvallis, and Agent, Bureau of Plant Industry, U. S. Dept. of Agriculture; Miss Ilda McVeigh, Assistant in Botany, University of Missouri, Columbia; Dr. Bassett Maguire, Professor of Botany, Utah Agricultural College, Logan; Mr. J. T. Middleton, Graduate Assistant, University of Missouri, Columbia; Dr. J. A. Moore, Head Dept. Biology, Huron College, Huron, S. D.; Dr. E. E. Naylor, Assistant Professor of Botany, University of Missouri, Columbia; Dr. A. C. Noé, Associate Professor of Botany, University of Chicago, Chicago, Ill.; Mr. Oliver Orton, Instructor in Botany, Oklahoma Agricultural College, Stillwater; Mr. E. J. Palmer, Collector and Research Assistant, Arnold Arboretum of Harvard University, Jamaica Plain, Mass.; Dr. Ruth Patrick, Assistant Curator, Academy of Natural Sciences, Philadelphia, Pa.; Mr. R. H. Peebles, Chief Scientific Aid, Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U. S. Dept. of Agriculture, Sacaton, Arizona; Dr. Francis Ramaley, Professor of Biology, University of Colorado, Boulder; Dr. H. W. Rickett, Associate Professor of botany, University of Missouri, Columbia; Dr. Walter Robyns, Director of the Jardin Botanique de l'État, Brussels, and Professor at the University of Louvain, Belgium; Mr. Reed Rollins, Junior Fellow at the Gray Herbarium of Harvard University, Cambridge, Mass.; Dr. Henry Schmitz, Professor and Chief of Division of Forestry, University of Minnesota, St. Paul; Dr. A. J. Sharp, Assistant Professor of Botany, University of Tennessee, Knoxville; Mr. Roger E. Sherman, Junior Horticulturist, U. S. Department of Agriculture, Soil Conservation Nursery, Elsberry, Mo.; Dr. Hiram Showalter, Professor of Biology, Kings College, Bristol, Tenn.; Dr. E. R. Spencer, Professor of Botany, McKendree College, Lebanon, Ill.; Dr. Julian A. Steyermark, Assistant

Curator of the Herbarium, Field Museum of Natural History, Chicago; Mr. A. D. Stoesz, of the Soil Conservation Service, U. S. Department of Agriculture, Washington, D. C.; Dr. Kogo Togashi, Professor of Plant Pathology, Hokkaido Imperial University, Sapporo, Japan; Mr. F. G. Walsingham, Horticulturist at the Atkins Institution of the Arnold Arboretum of Harvard University, Cienfuegos, Cuba; Dr. Robert W. Webb, Principal Cotton Technologist, Bureau of Agricultural Economics, Washington, D. C.; Prof. Rogers Winter, Professor of Physical Sciences, Hannibal-La Grange College, Hannibal, Mo.; Mr. Harry Wood, Head Gardener of the Arthur Hoyt Scott Horticultural Foundation, Swarthmore College, Swarthmore, Pa.; Mr. G. E. Woolliams, of the Dominion Laboratories, Summerland, B. C., Canada; Dr. Donald Wyman, Horticulturist, Arnold Arboretum of Harvard University, Jamaica Plain, Mass.; and Dr. F. L. Wynd, of the Department of Horticulture, University of Missouri, Columbia.

The following groups visited the library during the year: the botany classes of the University of Missouri and of Washington University; the University of Illinois library school; the science students from Hannibal-LaGrange College, Hannibal, Mo.; and the members attending the meetings of the Garden Club of America.

The library also loans books on the interlibrary loan plan, and 86 such loans were made to 28 institutions during 1937.

Statistical Information.—There have been donated to the library or received in exchange during the year 478 books valued at $1,426.54, 1,484 pamphlets valued at $307.48, and two manuscripts valued at $21.00. Two hundred and twenty-five books were bought at a cost of $2,214.56, and 68 pamphlets at a cost of $228.12. The library now contains 51,942 books and 79,809 pamphlets. There are 339 manuscripts valued at $1,660.40, and 1,039,414 index cards valued at $12,925.99. A total of 7,987 cards were added during the year, of which 830 were written by Garden employees, and 7,157 were purchased at a cost of $145.26. Four hundred and forty-four books were bound.

ANNUAL BEQUESTS

The annual flower sermon "On the wisdom and goodness of God as shown in the growth of flowers, fruits and other products of the

vegetable kingdom," provided for by Henry Shaw, was preached at Christ Church Cathedral on April 18, by Prof. Arthur H. Compton, of the University of Chicago.

The Trustees' Banquet Fund was not drawn upon during 1937.

The Gardeners' Banquet Fund was used for a dinner for all the employees of the Garden on the evening of June 1. Turkeys for certain employees at Christmas were likewise provided for from this fund.

Prizes in the form of silver cups, awarded by the St. Louis Horticultural Society, were furnished by the fund for this purpose set aside in the will of Henry Shaw.

GEORGE T. MOORE,
Director.

STATISTICAL INFORMATION FOR DECEMBER, 1937

GARDEN ATTENDANCE:

Total number of visitors	10,828

LIBRARY ACCESSIONS:

Total number of books bought	36
Total number of books and pamphlets donated	97

PLANT ACCESSIONS:

Total number of plants and seed packets received as gifts	90

HERBARIUM ACCESSIONS:

By Purchase—	
Lyonnet, E.—Plants of Mexico	500
By Gift—	
Demaree, Delzie—Plants of Arkansas	17
Drushel, J. A.—Plants of New Jersey	76
Martin, G. W.—Plants of Panama	16
Mille, Louis—Plants of Ecuador	4
Permond, F. G.—*Parmelia* sp. from New Mexico	1
Seibert, R. J.—Plants of Panama	27
Stokes, James—Plants of Georgia	49
By Exchange—	
California Academy of Sciences—Plants of California	118
Cornell University Herbarium—Plants of New York and Washington	46
Demaree, Delzie—Plants of Arkansas and Oklahoma	547
Field Museum of Natural History—Miscellaneous herbarium duplicates	500
Total	1,901

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Missouri Botanical Garden Bulletin

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and while virtually a private garden it was, except at certain stated times, always open to the public. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was designated by Mr. Shaw as its official title and in his will or in any of his writings he specifically referred to it as the "Missouri Botanical Garden." By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will, the immediate direction of the Garden is vested in a Director, appointed by the Board of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises 75 acres, where about 12,000 species of plants are growing. There is now in process of development a tract of land of over 1,600 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees, and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a wild-flower reservation, with the idea that possibly at some future time this may become the new botanical garden.

The Garden is open to the public every day in the year, except New Year's Day and Christmas—week days from 8:00 a. m. until sunset; Sundays from 10:00 a. m. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Place, on the Sarah car line (No. 42). Transfer south from all intersecting lines.

THEOBROMA CACAO (CHOCOLATE PLANT)

Missouri Botanical Garden Bulletin

Vol. XXVI FEBRUARY, 1938 No. 2

WHY PLANTS PREFER THE COUNTRY

The results of the recent survey made by the Mellon Institute to determine the concentration of volatile sulphur compounds in the air of St. Louis were no surprise to the plants at the Missouri Botanical Garden. Nor was it unexpected that the immediate vicinity of the Garden proved to be a locality in which occurred one of the higher concentrations of volatile sulphur. It has long been recognized that the acid formed by the addition of water to the gas produced from burning coal containing sulphur, and not just unconsumed carbon or soot, was the chief cause of damage to plants. Previous numbers of the BULLETIN have recorded and illustrated the effect of severe smoke clouds at the Garden, and the fact that certain plants can no longer be grown successfully in the city is well established.

A striking example of the difference between city and country atmosphere was recently obtained when the Garden attempted to grow *Theobroma Cacao,* the plant from which cocoa and chocolate is derived.

In September, 1936, ripe cocoa pods were obtained from which twelve seeds produced twelve young plants. During November all the seedlings were smoke-damaged, evidenced both by the falling of the young tender leaves and the characteristic scorching of the margins of the older leaves. In the latter part of November three of the twelve plants were sent to the greenhouse at the Arboretum, located thirty-five miles southwest of the city. By the following May only three of the original nine plants left in town were alive. As nearly as possible the culture of the plants in town and the country was the same; if anything the city plants had the greater

care. The accompanying plate (pl. 4) tells the story far better than words. The two plants in the background represent what one would naturally expect to find after a little more than a year's growth. It is hard to believe that the two stunted plants in the foreground are of the same age and so far as is possible to tell have had all the advantages of the larger plants except pure air. By looking closely it will be seen that the leaves of the country-grown plants are in perfect condition, even to the delicate pink leaves at the top. The city-grown plants show the brown or burned edges of the leaves, so characteristic of sulphur-gas damage.

Until the air of St. Louis can be freed from poisonous gases, it is little wonder that people, as well as plants, prefer to live in the country.

THE CHINESE ELM

The question of rapidity of growth always arises during any consideration of tree planting. Regardless of how well a certain tree might fit into a planting plan or planting site, its selection very often hinges upon the question, "How fast does it grow?" The deep-rooted feeling that "good" trees grow too slowly probably accounts for the very wide use of soft maple and sycamore on lawns and along streets.

Recently the Chinese elm (*Ulmus pumila* L.) has come into prominence solely because of its rapid growth. Certainly no other tree, hardy in this locality, can compete with it in this respect. However, rapid growth does not make for structural soundness, and this is also true of the Chinese elm.

The tree is found growing over a considerable portion of the northern parts of Asia. A number of distinct forms have been found, since it is an extremely variable species. Some of the earliest to arrive in this country were distinctly "weeds"; the erratic growth habit produced branches unable to withstand wind pressure or the weight of sleet. Since the first introduction in 1906 some of the better types have been imported, and a certain amount of selection has been carried on by the nurserymen in this country. At the present time it is possible to obtain varieties with branching habits more nearly like our native trees. Thus the Chinese

elm of today is less liable to storm damage although it appears from comparison with early accounts to have lost some of its speed of growth.

Six years ago, seventeen Chinese elms were inter-planted in a row of white ash, along the service road to the Shaw Avenue gate. After the elms had become established, the ash, by then nearly dead from borer attack, were removed. The following table shows the diameter of the elms at the time of planting, December 15, 1931, and after completing six years of growth, December 15, 1937.

GROWTH OF *ULMUS PUMILA* L.

Tree No.	West side		East side	
	Diameter when planted	Diameter after 6 years	Diameter when planted	Diameter after 6 years
1	1.7 inches	4.4 inches	2.3 inches	7.5 inches
2	1.6 inches	6.7 inches	1.2 inches	7.0 inches
3	2.0 inches	9.6 inches	1.5 inches	8.7 inches
4	1.3 inches	8.7 inches	1.4 inches	9.0 inches
5	2.2 inches	8.6 inches	1.6 inches	8.9 inches
6	1.9 inches	8.2 inches	1.1 inches	10.4 inches
7			2.7 inches	11.5 inches
8			2.1 inches	10.3 inches
9			2.3 inches	8.4 inches
10			2.3 inches	9.0 inches
11			2.2 inches	10.3 inches

While both rows are remarkably uniform in size and general habit, a glance at the table shows that the largest tree six years ago is still the largest tree. However, the smallest tree at the time of planting is now the second in size. These two trees are neighbors in the east row which touches the nursery, and they have benefited from the cultivation and irrigation carried on there. The trees in the west row are somewhat smaller. They have received no irrigation and very little cultivation. The adjoining field is overrun with "bindweed" and has been the scene of many weed-control experiments. It is evident from the measurements alone that even the Chinese elm will respond to good treatment. The tree does quite well without a great deal of water; it seems to like well-drained soil. It will not grow in a hole dug in impervious

clay. When planted in very tight soil, some provision should be made for drainage, at least for the first year.

If due consideration is given to the short-life expectancy of a tree of such rapid growth, it would seem that the Chinese elm is a valuable addition to the list of trees available for this locality. At the present time it is generally free of insect pests and diseases. Perhaps when more generally planted it will have its own list of troubles.

The largest tree of this species in the Garden measures 16.5 inches in diameter and was planted in 1918. It might be termed "mature," since it has reached the size when each severe storm breaks a branch from the crown. The rapid growth, however, tends to heal such openings rather quickly. To grow the Chinese elm to an age exceeding thirty years, it appears that the quaint local custom of "trimming" must be practiced. "Trimming" consists in lopping off all branches large enough to support foliage—just the trunk and scaffold limbs remain. However, a "trimmed" Chinese elm will be no better, and perhaps no worse, than a "trimmed" soft maple.

While conceding the value of the Chinese elm for particular situations, where the growth rate as well as the probability of storm damage has been considered, it is not a tree to plant for permanence or for future generations. Rapid growth and staunchness are not properties of the same tree. A. P. B.

THE BEHAVIOR OF A BASSWOOD DURING AN ARTIFICIAL WINDSTORM

During a study of the effects of weather on trees, it was often observed that wind checked growth. Although elaborate instruments were being used to obtain growth and weather records, it was not possible to separate the effects of wind from the other factors. In order to see what effect wind had upon a tree, it was necessary to construct a machine capable of producing a synthetic windstorm.

The simplest method, and the first to come to mind, was an airplane power plant and an air-screw. Although many such units have been used, notably in the cinema studios, this was probably

WIND MACHINE IN OPERATION

the first time one was used on a tree. There are certain technical problems involved in construction and operation of such machines which must be considered anew for each attempted application. For instance, the superstructure carrying the propeller—unless an airplane engine is used—must withstand considerable end thrust. Then, the under-carriage must be heavy enough to overcome the "lift" of the propeller over the entire operating range. The machine as finally built employed a propeller 76 inches in diameter and was driven by a 4-cylinder, air-cooled, 16-H. P. motor. The actual drive was through a multiple "V" belt. This placed the propeller nearly eight feet above the ground.

For a short period during the first day the machine was driven at various speeds. At its fastest it developed a wind-storm of forty miles an hour and was capable of "pushing" the 1800-pound wheeled cart on which it was mounted. It was immediately apparent that such high velocities would cause mechanical injury to the foliage. Above twenty-five miles an hour, the wind held the leaves in a fixed position, usually folded, and allowed no respite from the blast. Finally a speed of approximately twice the normal wind movement was employed. With the motor governor set for 960 r. p. m., a blast of 17½ miles an hour was developed. This speed was maintained throughout the experiment. The lower velocity permitted the branches to sway back and forth, and the leaves, should they have been folded or turned, to recover their natural positions. The artificial blast, although about twice as strong, was very much like a normal wind. It moved back and forth across the tree, being influenced by every breeze from any direction. The machine was set up on the south side of the tree, blowing from the south to the north, and it remained in that position during the following weeks.

The tree used in this work was an American linden or basswood (*Tilia americana* L.). It was selected because of size and convenient location. It was 5½ inches in diameter, with a height of 15 feet and a branch spread of 9 feet. Thus the blast of wind covered the entire tree. Another reason for its selection was its rapid reaction to excessive water loss, due to the fact that several annual layers of wood are concerned in water conduction.

Actual operation began on June 30, 1937. The speed varied

and the operation was intermittent until about 3:00 p. m., when the governor was locked. Following is a tabulation of the operating days and the hours in actual use:

June	30	6 hours
July	1	7 hours
July	2	9 hours
July	3	Quiet
July	4	Quiet
July	5	Quiet
July	6	8½ hours
July	7	8 hours
July	8	9 hours
July	9	9 hours
July	10	9 hours
July	11	Quiet
July	12	9 hours
July	13	9 hours
July	14	9 hours
Total		92½ hours

In effect, then, the tree was swept by wind about twice as strong as usual, but for only a portion of the daylight hours. The early morning and late evening, as well as the entire night, were available for unhindered water replenishment.

From earlier studies it is known that trees lose water during the day and consequently shrink in diameter. The water loss is made up during the night when conditions are not so favorable for evaporation. Thus, each day of twenty-four hours, a tree will expand and contract, and this characteristic behavior lends itself to measurement. The dendrograph, first developed and used by MacDougal, is used for this purpose. The instrument encircles the trunk and gives a continuous automatic record of diameter fluctuations. Therefore, it furnishes a record which is used as the key in evaluating the effects of external forces on tree growth. In this report only one factor—the wind—will be considered, although some mention will be made of trunk temperature and soil moisture.

The dendrograph record of a normal basswood shows that the peak in diameter is reached about 6:00 a. m. during July. The exact hour varies somewhat during the season, but shortly after this, on sunny days, the tree begins to contract due to loss of

water. The shrinkage is continuous and proceeds at a uniform rate until about 4:00 p. m. This is followed by a short quiescent period, then within the next three hours expansion begins. However, when the tree is undergoing excessive evaporation the contraction period is much shortened. For instance, fifteen minutes after starting the wind machine the tree had shrunk as much as it would for that day. The quiescent period was, of course, greatly lengthened, and the expansion period delayed until the wind machine was stopped that evening. As the forced drying-out continued day after day certain changes became apparent from the dendrograph. First, the entire night was required for the tree to absorb enough water to regain its lost diameter. Second, the amount of shrinkage became less and less. Since there was but a minimum amount of water available for use, it was being held more tenaciously. Death would have followed the loss of this "bound" water. At the beginning of the third week, or after 92½ hours of exposure, the dendrograph record was almost a straight line. The absence of diurnal fluctuations indicated clearly—just as was apparent from observation—that the tree could withstand but little more abuse.

At this time another dendrograph was attached which gave a reading of the east and west diameter. The first instrument recorded the south to north axis, in line with the wind direction. The east-west dendrograph yielded a record of a nearly normal tree, the only departure being the extreme daily fluctuations and the instantaneous response to even slight amounts of rainfall. The effect of rain will be considered later. The amplitude of the daily changes might be expressed thus, assuming that the figure 100 represents a normal tree.

East-west axis	:	120 with ample soil water.
East-west axis	:	65 with decreasing soil moisture.
North-south axis	:	10 after 92½ hours.

Between July 14 and August 22, the wind machine was used for short periods during certain days, merely to observe the degree of recovery. However, this tree was unable to regain enough water to function again as a normal tree. The use of a dendrograph for diagnostic purposes under certain conditions is clearly shown in

this experiment. No attempt was made to irrigate the tree, and no rain of consequence fell during the period of observation. However, on three occasions slight showers produced striking reactions. In no case was precipitation sufficiently heavy to percolate beneath the grass roots, and no additional water became available to the tree. The first shower occurred on July 3, while the wind machine was not operating and before the tree had become badly desiccated. As is usual with a normal tree after a rain the expansion began about two hours ahead of schedule. Another shower at 7:00 a. m., July 4, likewise showed the tree to be normal, since there was no contraction that day. However, a third shower, on July 9 after the tree had undergone forced drying, caused an immediate expansion which continued until the tree had regained full diameter. Although the wind machine ran continuously until 5:00 p. m. the tree had accomplished in the two preceding hours what usually required the entire night. During the last week two showers fell during the day, and the dendrograph recorded that expansion began within fifteen minutes. A soil-moisture determination made on July 14 showed 18 per cent in the upper twelve inches, 16 per cent in the second foot, and 13.5 per cent in the third foot. The progressively decreasing moisture at lower levels indicates the utilization of water by a tree under such conditions.

The BULLETIN has previously reported the relationship between trunk temperature and soil moisture. It has pointed out that wilting may occur if moisture is deficient and high-air temperatures continue. Under drought conditions evaporation is checked, and its cooling effect is lost. Finally the trunk temperature reaches 86.5° F. and wilting follows. This study is concerned with excessive evaporation at lower air temperatures. Nevertheless, wilting occurred, although trunk temperatures remained within the normal limits. There was an increase in trunk temperature from 71° F. to 77° F. during the period of observation. It was also possible to depress quickly the trunk temperature one degree when the wind machine was started. But in the absence of high-air temperatures, excessive wind may be equally destructive.

The experiment reported here has some bearing on tree planting and tree care. It shows that growth may be restricted, and that wilting or even death may follow when trees are exposed

to excessive wind. It shows that wilting may occur although air temperatures are low and ample soil water is available. It may offer a solution to some of our planting problems. The sad results which often follow the planting of such species as redbud, dogwood, or even spruce, in certain locations, may in a large measure be due to wind alone. Many of the smaller trees and shrubs used in border plantings grow as the under-story in the forest. In their natural habitat they are protected on all sides from wind. The basswood used in the experiment grows to a large tree and frequently becomes the dominant tree in a wood-lot; yet it proved unable to withstand twice the normal amount of wind, and this for but a portion of each day during a fraction of the whole growing season.

A. P. B.

MOLLUSCA OF THE MISSOURI BOTANICAL GARDEN ARBORETUM

It may at first sight seem a long way from clams to wild flowers or from snails to trees; yet between the plants and animals which inhabit any particular locality there are so many inter-relations that each species affects every other. A precise knowledge of one group of organisms will be helpful in understanding any of the other groups. The following list, prepared by Mr. Leslie Hubricht, will be increasingly useful as the wild-flower gardens develop.

LAND SNAILS

Species of the flood-plain woods:

Lobosculum leporinum (Gould)
Polygyra hirsuta (Say)
Polygyra appressa (Say)
Polygyra appressa fosteri Baker
Polygyra thyroides (Say)
Zonitoides arboreus (Say)
Zonitoides ligerus Say)
Hawaiia minuscula (Binney)
Retinella indentata (Say)
Euconulus chersinus polygyratus Pilsbry
Philomycus carolinianus (Bosc)
Pallifera sp. near *wetherbyi* (Binney)
Deroceras laeve (Müller)
Punctum pygmaeum (Draparnaud)
Helicodiscus parallelus (Say)
Haplotrema concavum (Say)
Gastrocopta contracta (Say)
Gastrocopta tappaniana (C. B. Adams)
Succinea grosvenori Lea
Carychium exile (C. H. Lea)
Pomatiopsis lapidaria (Say)

Species of the cliffs and talus slopes:

Polygyra fraterna (Say)
Polygyra inflecta (Say)
Polygyra tridentata frisoni Baker
Polygyra albolabris alleni (Wetherby)
Polygyra zaleta (Binney)
Anguispira kochi (Pfeiffer)
Anguispira alternata (Say)
Strobilops labyrinthica (Say)

Species of the glades:

Pupoides marginatus (Say)
Gastrocopta procera (Gould)

AMPHIBIOUS SNAILS

On wet rocks about the spring:

Lymnaea (Fossaria) parva (Say)

AQUATIC SNAILS

Species of the Meramec River:

Menetus sampsoni (Ancey)
Ferrissia tarda (Say)
Ferrissia kirklandi (Walker)
Physa halei Lea
Campeloma integrum (Say)
Cincinnatia cincinnatiensis (Anthony)
Pleurocera acuta Rafinesque

Species of the temporary pools:

Lymnaea (Stagnalis) caperata (Say)
Helisoma trivolvis pseudotrivolvis (Baker)

MUSSELS

The mussels are all confined to the Meramec River. In comparison with other points in the Meramec River, the mussel fauna of the river at the Arboretum is poor, both in the number of species and of individuals. This is probably due to the shifting bottom.

Ligumia recta (Lam). Black Sand Shell
Lampsilis anodontoides (Lea). Yellow Sand Shell
Lampsilis fallaciosa (Simp.). Slough Sand Shell
Lampsilis ventricosa (Barnes). Pocketbook
Actinonaias carinata (Barnes). Mucket
Actinonaias ellipsiformis (Con.). Ellipse
Proptera alata (Say). Pink Heel-Splitter
Leptodea fragilis Raf. Fragile Paper Shell
Obovaria olivaria (Con.). Hickory-Nut
Plagiola lineolata Raf. Butterfly
Truncilla truncata (Raf.). Deer-Toe
Obliquaria reflexa Raf. Three-Horned Warty-Back
Lasmigona complanata (Barnes). White Heel-Splitter
Lasmigona costata Raf. Fluted Shell

Alasmidonta marginata (Say). Nigger-Toe
Elliptio dilatatus Raf. Spike
Pleurobema coccineum solida (Lea). Small Niggerhead
Fusconaia undata (Barnes). Pig-Toe
Fusconaia ebenus (Lea). Niggerhead
Quadrula pustulosa prasina (Conrad). Flat Pimple-Back
Quadrula metanevra Raf. Monkey-Face
Tritogonia verrucosa Raf. Buckhorn
Plethobasus cyphyus Raf. Bullhead
Cyclonaias tuberculata Raf. Purple Pimple-Back
Amblema perplicata quintardi (Cragin). Little Blue-Point
Margaritana monodonta (Say). Spectacle-Case
Sphaerium staminium (Conrad)
Sphaerium striatinum (Lam.)
Musculium transversum (Say)

FURTHER COMMENT ABOUT HARDY GLADIOLI AND ALOE VERA

Mr. Wyndham Hayward, of Winter Park, Florida, comments as follows on the article concerning hardy gladioli in the December, 1937, number of the BULLETIN:

"About 1931 when I was in Massachusetts after a fairly hard winter, I recall driving along a country road where the year before a grower had several acres of gladiolus. There was just one bulb blooming in the middle of the several acres. It had of course managed to survive a New England winter without special protection. In Florida where we are not troubled with the problem of winter hardiness we are able to allow gladiolus to remain several years as a permanent perennial in the garden planting, quite often, in well-drained but not too dry soil. The Primulinus types seem to be very successful in this way."

Mr. Hayward also says, in connection with the article on *Aloe vera* in the same BULLETIN:

"I have never heard of its use for sunburn, but I have heard it highly recommended as a specific for 'black eyes.' Just smear the jelly from the inside of the leaf around the injured optic and it helps take out the sting."

ATTENDANCE FOR 1937

(Not including visitors to Arboretum and Tropical Station)

	Week-days	Sundays
January	4,045	2,728
February	11,590	11,218
March	15,528	18,064
April	10,832	10,260
May	26,105	26,633
June	20,921	11,989
July	24,215	11,346
August	26,631	16,110
September	18,196	12,771
October	20,819	13,901
November	34,058	25,179
December	6,834	3,994
	219,774	164,193
		219,774
Total		383,967

NOTES

Dr. George T. Moore, Director of the Garden, spoke at the Union Avenue Christian Church, January 28, on "The Garden and Its Founder."

Dr. Hermann von Schrenk, Pathologist to the Garden, spoke before the Western Society of Engineers, at Chicago, Ill., January 18, on "Termites."

Mr. Paul A. Kohl, Floriculturist to the Garden, gave a talk before the St. Louis Hills Garden Club, January 11, entitled, "If I Were to Make a Garden."

"Is the Gladiolus Hardy in Missouri?" an article from the December BULLETIN, by Dr. David C. Fairburn, Horticulturist to the Garden, was reprinted in the January 13 issue of *Florists' Review*.

Mr. A. P. Beilmann, Arboriculturist to the Garden, has given the following talks recently: January 10, "The General Care of Trees," before the Men's Garden Club, at Des Moines, Iowa; January 12, "The Feeding of Shade Trees," before the Illinois State

Nurserymen's Association, Chicago, Ill.; January 28, "Trees," at the annual meeting of the Webster Groves Garden Clubs.

Mr. George H. Pring spoke at Ohio State University, Columbus, January 10, on "Orchid Culture," and January 11, on "Taxonomy of Orchids"; January 12, before the Columbus Landscape Association, on "New Introductions Growing at the Arboretum at Gray Summit." He gave two illustrated lectures at Boston, February 9: in the afternoon, before the Massachusetts Horticultural Society, on "The Breeding and Growing of Water-lilies," and in the evening, before the Horticultural Club, on "Gardening in the West."

Recent visitors to the Garden include: Dr. Theodosius Dobzhansky, Professor of Genetics, California Institute of Technology, Pasadena; Dr. Harry J. Fuller, Assistant Professor of Botany, University of Illinois, Urbana; Mr. J. J. Grullemann, President of Wayside Gardens, Mentor, Ohio; Dr. Gustav Klem, of the Norwegian Forestry Research Institute, Aas, Norway; Dr. R. McVaugh, Assistant Professor of Botany, Mr. J. H. Pyron, Instructor in Botany, and Mr. Eugene Adams, Graduate Student in Botany, all of the University of Georgia, Athens; Mr. J. T. Middleton, Graduate Assistant, Dr. E. E. Naylor, Assistant Professor of Botany, and Dr. F. L. Wynd, visiting Assistant Professor of Botany, all of the University of Missouri, Columbia; Mr. Ralph O. Marts, of the U. S. Forest Products Laboratory, Madison, Wisconsin; Mr. Jose Mendoza Montenegro, Civil Engineer with the Federal Department of Forestry and Fish and Game of the Mexican Government; Mr. Henry de la Montagne, Assistant Director, and Thomas H. Everett, Horticulturist, New York Botanical Garden; Dr. E. R. Spencer, Professor of Botany, McKendree College, Lebanon, Ill.; Mr. William Schwab, Head Department Science, Madison High School, Madison, Ill.

The seventieth birthday of Dr. J. M. Greenman, Curator of the Herbarium, was celebrated December 27, 1937, with a dinner given by his students and members of the Shaw School of Botany staff, at the Hotel Claypool, Indianapolis. Students of Dr. Greenman present on the occasion were the following: Dr. Earl Edward Sherff, Head Department of Science, Chicago Normal College,

and Research Associate in Systematic Botany, Field Museum of Natural History; Dr. Carl C. Epling, Associate Professor of Botany, University of California at Los Angeles; Dr. Clarence E. Kobuski, Asssistant Curator of the Herbarium, Arnold Arboretum of Harvard University; Dr. Robert E. Woodson, Jr., Assistant Curator of the Herbarium, Missouri Botanical Garden, and Assistant Professor of Botany, Shaw School of Botany of Washington University; Mr. Edgar L. Evinger, Associate Soil Conservationist, Division of Research, U. S. Dept. Agr.; Dr. Julian A. Steyermark, Assistant Curator of the Herbarium, Field Museum of Natural History; Dr. Caroline K. Allen, Assistant in the Herbarium, Arnold Arboretum of Harvard University; Dr. George J. Goodman, Assistant Professor of Botany, Iowa State College; Miss Maxine Larisey, Instructor in Botany, Shaw School of Botany of Washington University; Dr. George Bippus Happ, Assistant Professor of Biology, Principia College, Elsah, Ill.; Mr. Russell J. Seibert and Hugh C. Cutler, Graduate Assistants, Shaw School of Botany of Washington University; Mr. Francis M. Ownbey, University Fellow, Shaw School of Botany of Washington University. A special number of the ANNALS containing papers by seven of Dr. Greenman's former students was issued in commemoration of the event and presented to Dr. Greenman at the dinner. The volume was later issued as the February, 1938, number of the ANNALS (Vol. XXV, No. 1). Its contents are as follows: "Revision of the Hawaiian Species of *Euphorbia* L.," Earl E. Sherff; "The Californian Salvias. A Review of *Salvia*, sect. Audibertia," Carl Epling; "Studies in the Apocynaceae. VII. An Evaluation of the Genera *Plumeria* L. and *Himatanthus* Willd.," Robert E. Woodson, Jr.; "A Revision of the Genus *Lomatium*," Mildred E. Mathias; "Studies in Theaceae. III. *Eurya* subg. Eurvodes and Penteurya," Clarence E. Kobuski; "Studies in the Lauraceae. I. Chinese and Indo-Chinese Species of *Litsea*, *Neolitsea*, and *Actinodaphne*," Caroline K. Allen; "A Monograph of the Genus *Hemimeris*," Adele Lewis Grant.

STATISTICAL INFORMATION FOR JANUARY, 1938

GARDEN ATTENDANCE:

Total number of visitors 16,117

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought 37
Total number of books and pamphlets donated 78

HERBARIUM ACCESSIONS:

By Purchase—

Fisher, George L.—Plants of Mexico 126
Ownbey, Marion—Plants of Colorado and Wyoming 250
University of Michigan—Plants of Mexico, collected by Eizi Matuda 525
Verdoorn, Fr.—"Musci selecti et critici," Series V, Nos. 201-250 inclusive 50

By Gift—

Chandler, Albert—Plants of New Hampshire and Missouri ... 104
Cutler, Hugh C.—Plants of Oklahoma, Texas, New Mexico, and Arizona 69
Demaree, Delzie—Plants of Arkansas 2
Dodge, C. W.—Plants of Costa Rica 45
Hubricht, Leslie—Plants of Illinois and Missouri 4
MacGinitie, H. D.—Plants of California 3
White, Misses Gene and Peggy, by R. E. Woodson, Jr. and R. J. Seibert—Plants of Panama 2

By Exchange—

Beetle, Alan A.—Plants of Colorado 140
Demaree, Delzie—Plants of Arkansas 307
Desert Laboratory, Tucson, Arizona—Plants of Arizona and Mexico 230
Pomona College, California—Plants of western United States, collected by Marcus E. Jones 323
U. S. National Museum—Plants of South America 2
University of Michigan—Plants of Mexico and Central America 117
Barkley, Fred A.—Plants of Montana 142
University of Washington—Plants of Washington and Alaska 82

By Field Work—

Allen, Paul H., by R. E. Woodson, Jr. and R. J. Seibert—Plants of Panama 26

By Transfer—

Horner, Miss Nell C.—Plates from the ANNALS OF THE MISSOURI BOTANICAL GARDEN 29

Total 2,578

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Missouri Botanical Garden Bulletin

Vol. XXVI MARCH, 1938 No. 3

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and while virtually a private garden it was, except at certain stated times, always open to the public. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was designated by Mr. Shaw as its official title and in his will or in any of his writings he specifically referred to it as the "Missouri Botanical Garden." By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will, the immediate direction of the Garden is vested in a Director, appointed by the Board of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises 75 acres, where about 12,000 species of plants are growing. There is now in process of development a tract of land of over 1,600 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees, and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a wild-flower reservation, with the idea that possibly at some future time this may become the new botanical garden.

The Garden is open to the public every day in the year, except New Year's Day and Christmas—week days from 8:00 a. m. until sunset; Sundays from 10:00 a. m. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Place, on the Sarah car line (No. 42). Transfer south from all intersecting lines.

1

2

3

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LIVING PEBBLES AND STONES

1. *Imitaria Muirii.* 2. *Pleiospilos simulans.* 3. *Lithops* sp. 4. *Stomatium murinum.* 5. *Conophytum Luisae.* 6. *Lithops kunjasensis.*

Missouri Botanical Garden Bulletin

Vol. XXVI MARCH, 1938 No. 3

LIVING PEBBLES AND STONES

If you are numbered among those who seek the odd and fantastic in plant life, you will be interested in the stone-like plants from the warm, dry regions of South Africa. Curious diminutive mimics they are, with lovely blossoms of radiant shades, and yet easily grown under the most ordinary conditions. If ever a succulent merited a trial in the home, the "stone and pebble" plants certainly do.

Originally "stone plants" were included in a single genus, Mesembryanthemum, on account of the similarity of their flowers. In recent years, however, various students of this plant group, among whom are the late Dr. N. E. Brown of Kew, Louisa Bolus of South Africa, and Dinter and Schwantes of Germany, have divided the genus into over one hundred genera, many monotypic. When referring to these plants, the term "mesembryanthema" or "mesembs" is generally used. Jacob Breyne (or Breynius) was apparently the first to use the descriptive name of Mesembrianthemum (note the spelling) in his "Catalogue of Rare Plants," published in 1689. The name is derived from two Greek words meaning "noon-day flower" because the blooms of the early-known species opened during the mid-day period. Linnaeus, the father of modern botany, changed the "i" into "y," and most modern taxonomists follow his spelling. The genus, as early as 1648, contained about fifteen species. Since that time, many other kinds have been found that open their flowers at various periods, some even being nocturnal. By 1862 about 293 species had been described. The newer genera all bear descriptive names, Argyro-

derma, Conophytum, Glottiphyllum, Lithops, Pleiospilos, Titanopsis, meaning "silver-skins," "cone plants," "tongue plants," "stone faces," "spotted plants," and "limestone mimics," respectively. This group of "mesembs" is mostly stemless, and looks very different from the shrubby and trailing types that are grown extensively in California gardens for their very gorgeous floral carpets of rose, scarlet, orange, golden yellow, shell pink, and glowing purple. However, the former, with their uncanny resemblance to the stones around which they grow, are far more fascinating and are much more sought after by connoisseurs of bizarre things.

A sunny location is a primary requisite if these plants are to thrive. Growing among the rocks or embedded in sand in their natural habitats, where the sun often beats down upon them mercilessly and where rainfall is limited, they have adapted themselves to most severe conditions. They can, therefore, be grown in any home upon the window-sill. Fresh air is almost as important as sunlight, but despite the lack of it during the cold wintry days the plants will survive. Even hot-air heat and house gas do not seem to affect these plants, but an atmosphere surcharged with sulphurous fumes is detrimental.

On the whole, stone and pebble plants make but modest demands upon the soil from which they draw their nourishment. Although they will live in almost any kind of soil, those heavily manured should be avoided. The stone plants at the Garden are grown in a soil mixture composed of equal parts of well-rotted leaf-mold, sand, and compost, screened through a quarter-inch mesh. Gravel and broken fragments of limestone are placed around the plants, this as a precaution against rot diseases which often set in when the succulent bodies come in contact with the wet soil.

As to watering, the rule for most succulents, "rather less than too much," should be observed. The watering of the more delicate species of Conophytum, Fenestraria, etc., is really an art that cannot be explained by words, but is acquired only by experience. Never water on cool cloudy days or when the sun's rays are directly on the plants. The best method of watering "mesembs" is from below. A long narrow tray (preferably one to two inches in

depth) that fits into the window will be found very convenient for holding pots of "mesembs." When moisture is necessary, fill this receptacle with water, allow a slight wetness to penetrate to the top of the soil, then immediately pour off the excess water from the tray, and the watering problem is solved. Repeat this operation when necessary. For indoor culture, never water overhead except under favorable conditions, and then only when the plants are growing vigorously. A syringe is beneficial for most plants, but succulents do not tolerate water on their bodies for lengthy periods, especially during the cool, cloudy wintry days of our temperate climates. More stone plants will be lost during our mid-western dormant season than at any other time of the year, if watering is not controlled. All the "succulent mimics" are so constructed that they are able to retain and hoard up moisture for a long time. Evaporation is much more limited in these kinds than in non-xerophytic plants, so that watering once or twice a month should suffice for those grown in the home.

When "planting "mesembs," do not have the pots too large or too deep. The ordinary four-inch porous flower pot is excellent, but better still is a six-inch seed pan (that having a depth of 3½ inches). In such a container several plants can be grown. Drainage is of the greatest importance, and can be assured by placing pot shreds and gravel in the bottom of the container.

A very successful way of accumulating a notable collection of stone plants is to grow them from seed. Seed is procurable at a very reasonable price from many reliable concerns here and abroad. In America "mesembs" and seeds can be procured from the following dealers: Rio Grande Valley Cactus Garden, Edinburg, Texas; R. W. Kelly, El Monte, California; Knickerbocker Nursery, San Diego, California; Johnson Water and Cactus Gardens, Hynes, California; Poindexter Nursery, Compton, California; and several others. Wilhelm Triebner, of Windhoek, South West Africa, claims to have the largest collection of Mesembryanthema and he produces a general price list for his customers. Many German firms seem to have a monopoly on choice succulent seeds, and these include: Albert Schenkel, Hamburg; R. Graessner, Perleberg; Friederich Haage, Jr., Erfurt; Robert Blossfeld, Potsdam; H. Winter, Franfurt am Main; and Curt Backeberg, Hamburg.

Fresh seed is preferable to old, but the writer has had good results from seed two and three years old. It is advisable not to sow all the seed at one time. In the greenhouse the time of sowing is not restricted to any particular season, but in the average home spring is the ideal period. Regular seed-pans or the handy four-inch porous pots are generally used for this purpose. The same type of soil as listed previously can be used, but the top layer upon which the seeds are broadcast should be sifted through a fine 18-mesh screen such as is used for window and door screens. Several pieces of broken pot are placed in the bottom of the pot for drainage, coarse compost added and tamped down firmly, then a sifting of finely screened soil. Seed is broadcast over the top and covered very lightly with the same fine mixture tamped evenly once more. The pot is then placed in a pan of water to absorb the needed moisture. Cover seed-pots with a square piece of glass, place in a warm but shaded position, and never allow the soil to become dry, even after germination. Avoid having the soil too wet, however.

After germination remove the glass cover, and shield the seedlings with newspaper from the direct sunlight. Transplanting need not be performed for a long time, unless the small plants are very crowded and there is danger of damping-off disease. Too early transplanting is not recommended, because the seedlings have but a very fine short root and there is great danger of injuring this organ in the shifting process.

Most "mesembs," especially of the mimic type, will germinate within a week or two from time of sowing seed. This includes such genera as Argyroderma, Cheiridopsis, Conophytum, Dactylopsis, Dinteranthus, Fenestraria, Gibbaeum, Glottiphyllum, Juttadinteria, Lithops, Rimaria, Titanopsis, and many others. A recent experiment, one of many conducted to date, may be of interest to culturists and is appended here. The seed used was two to three years old.

"Mesembs" of the fig-marigold type (so called because the fruits look like figs and the flowers like marigolds) begin to bloom at an early age, but most of the "mimics" will require from three to five years from time of sowing. *Aridaria resurgens* has germinated in fourteen days, and was in bloom exactly five and one-half

Plant	*Date seed sown*	*Date of germination*	*Percent of germination*
Aloinopsis Jamesii	December 30, 1937	January 9, 1938	85
Aloinopsis Peersii	December 30, 1937	January 9, 1938	75
Argyroderma testiculare	December 30, 1937	January 5, 1938	90
Cheiridopsis cigarettifera	December 30, 1937	January 5, 1938	90
Cheiridopsis Comptonii	December 30, 1937	January 9, 1938	50
Cheiridopsis peculiaris	December 30, 1937	January 7, 1938	60
Conophytum purpureum	December 30, 1937	January 16, 1938	85
Dinteranthus microspermus	December 30, 1937	January 16, 1938	45
Faucaria crassisepala	December 30, 1937	January 12, 1938	50
Faucaria Duncanii	December 30, 1937	January 13, 1938	50
Faucaria hyneveldiae	December 30, 1937	January 13, 1938	50
Juttadinteria Simpsonii	December 30, 1937	January 16, 1938	35
Lithops Lesliei	December 30, 1937	January 8, 1938	70
Lithops pseudotruncatella	December 30, 1937	January 8, 1938	70
Lithops terricolor	December 30, 1937	January 8, 1938	65
Titanopsis calcareus	December 30, 1937	January 8, 1938	50

months later. The Faucarias, or tiger jaws, usually germinate in fourteen to seventeen days and bloom in the eighteenth month. Lithops require four and five years to reach the flowering stage, although some species may flower as early as three years. Conophytums have produced blossoms in three and four years, as have Imitarias, Fenestrarias, Lapidarias, Lithops, Rimarias, Titanopsis, etc.

Insects and bacterial diseases may play havoc with a "living stone" collection unless a careful watch is maintained. Absolute care must be exercised when handling these succulent sphaeroids, for an ever so slight bruise or damage will be an entry point for bacteria. Often the whole plant will suddenly topple over in a heap of watery tissue, to the utter sorrow of a collector. Mealy bugs, red spider, and thrips are common insects that readily attack these curious "mesembs," but an occasional spraying will keep such pests in check. Mealy bugs around the roots are hardest to detect, for they cannot be seen until the damage has been done. Whenever any "mesemb" appears sickly and shrivelled and no cause for this condition is apparent, examine the root system for

these root lice. As a remedy, wash roots in water, dip in alcohol for a minute or two, and repot in new soil. Mealy bugs often congregate beneath the old withered leaves, remaining about the base of Lithops, Conophytums, etc., and in the orifice or slit that extends directly across the body. Thrips disfigure these plants with their characteristic rasp-like markings. An occasional spray with nicotine or one of the commercial insecticides will keep stone-like "mesembs" insect-free. In greenhouse culture, sow-bugs and millipeds will frequently attack the roots and juicy stems, and they are also responsible for the dissemination of bacterial diseases. Rid the premises of these pests.

There is a long list of South African "mimic" plants from which to choose. Foremost among these are the Lithops, or stone-faces, with their reddish, whitish, brown, or rust-colored tops, often mottled, and closely resembling the soil, stones, and pebbles among which they grow. At the present time about fifty species are recognized by botanists. Over a century ago, Burchell picked up one of the first Lithops, thinking it was a pebble, when lo! to his astonishment, it turned out to be a living plant. One of the easiest and most attractive species to grow and one that can stand quite a bit of water during the summer is *Lithops Lesliei,* from Transvaal. It possesses a flattened top that is deep red and brown in color. Some other interesting species are *Lithops alpina,* an early-blooming form, *L. Aucampii, L. bella, L. Comptonii, L. Dinteri, L. Eberlanzii, L. Elisabethae, L. Erniana, L. floris albis, L. Fulleri, L. fulviceps, L. gracilidelineata, L. Julii, L. karasmontana, L. kuibisensis, L. kunjasensis, L. marmorata, L. Meyeri, L. mickbergensis, L. Mundtii, L. optica, L. opalina, L. Peersii, L. pseudotruncatella, L. rugosa, L. Ruschiorum, L. summitatum, L. terricolor, L. turbiniformis, L. umdausensis, L. urikosensis, L. Vallis-Mariae,* and *L. Vanzijlii.*

Next to the Lithops, the Conophytums or "cone plants" are perhaps the most desirable. Usually growing in a cluster of globose to obconic bodies, they are the smallest of all "mesembs," free-flowering when given plenty of sunlight and rest during the early summer months. There are about 130 species, all preferring the hollows and crevices of rocks in South Africa. The first of the Conophytums discovered was *C. truncatum* before 1791, when of

course it was known as *Mesembryanthemum truncatum.* Some of the outstanding species are *Conophytum altum, C. Ernianum, C. Maughani, C. minusculum, C. translucens, C. minutiflorum, C. Purpusii, C. odoratum, C. Luisae,* and *C. vanrhynsdorpense.*

The Argyrodermas, answering to the name of "silver-skins," are most peculiar plants, growing among the white quartz rock in their natural habitat. Only two pairs of thickened leaves appear at one time, these firm in texture and covered with a very smooth, white skin. The most notable species is *Argyroderma testiculare* with silver-gray leaves. It has been in cultivation for over a hundred years. Other worth-while species are *A. Jacobsenianum* and *A. Schlechteri.*

Plants of the genus Gibbaeum are commonly called "gouty plants." Many of these grow among the white quartz rock and bear the closest similarity in color and texture to their background. There are about eleven species, some with small, velvety, chocolate-colored finger-like leaves, others with very curious, spherical, stone-like growths, and still others forming dense mats of green, quaintly shaped leaves. *Gibbaeum pubescens* was already in cultivation as early as 1795. Other Gibbaeums include *G. album, G. angulipes, G. dispar, G. geminum, G. molle, G. pachypodium, G. perviride, G. pilosulum, G. Shandii, G. Bosscheana,* and *G. velutinum.*

The Fenestrarias are notable curiosities, in which the tufted club-like leaves have a window in the tips. Growing in the sand deserts of South West Africa, the plants are almost entirely covered with sand, except for these transparent windows which admit light to the plant, and without which the plants could not possibly live. There are two species, the white-flowered *Fenestraria rhopalophylla,* known as "baby toes," and the golden-flowered *F. aurantiaca.*

The Pleiospilos look so much like fragments of rock that one is often forced to feel the leaves to convince himself that he is touching a plant. All the species bear thick, angular leaves, some resembling water-worn stone and others successfully disguising as the shale in their natural surroundings. All Pleiospilos are easy of culture, perhaps the easiest of all the stone-shaped "mesembs," and it might be worth while for the novice to begin with these be-

fore attempting Conophytums, Argyrodermas, Fenestrarias, and the like. The most sought-after species are *Pleiospilos Bolusi* and its very near relative, *P. simulans*. The flowers are bright yellow, have a very pleasant odor, and open towards evening for about fourteen days.

The limestone rosettes, or Titanopsis, are well-named. Composed of flat rosettes of rough-surfaced leaves, they so strikingly resemble calcareous matter that they might be taken for beautiful coral rather than a member of the plant kingdom. The encrusted tips of the leaves will assume a brilliant violet color when the plant is grown in the full sun and not watered too much. By all means include the Titanopsis in your collection.

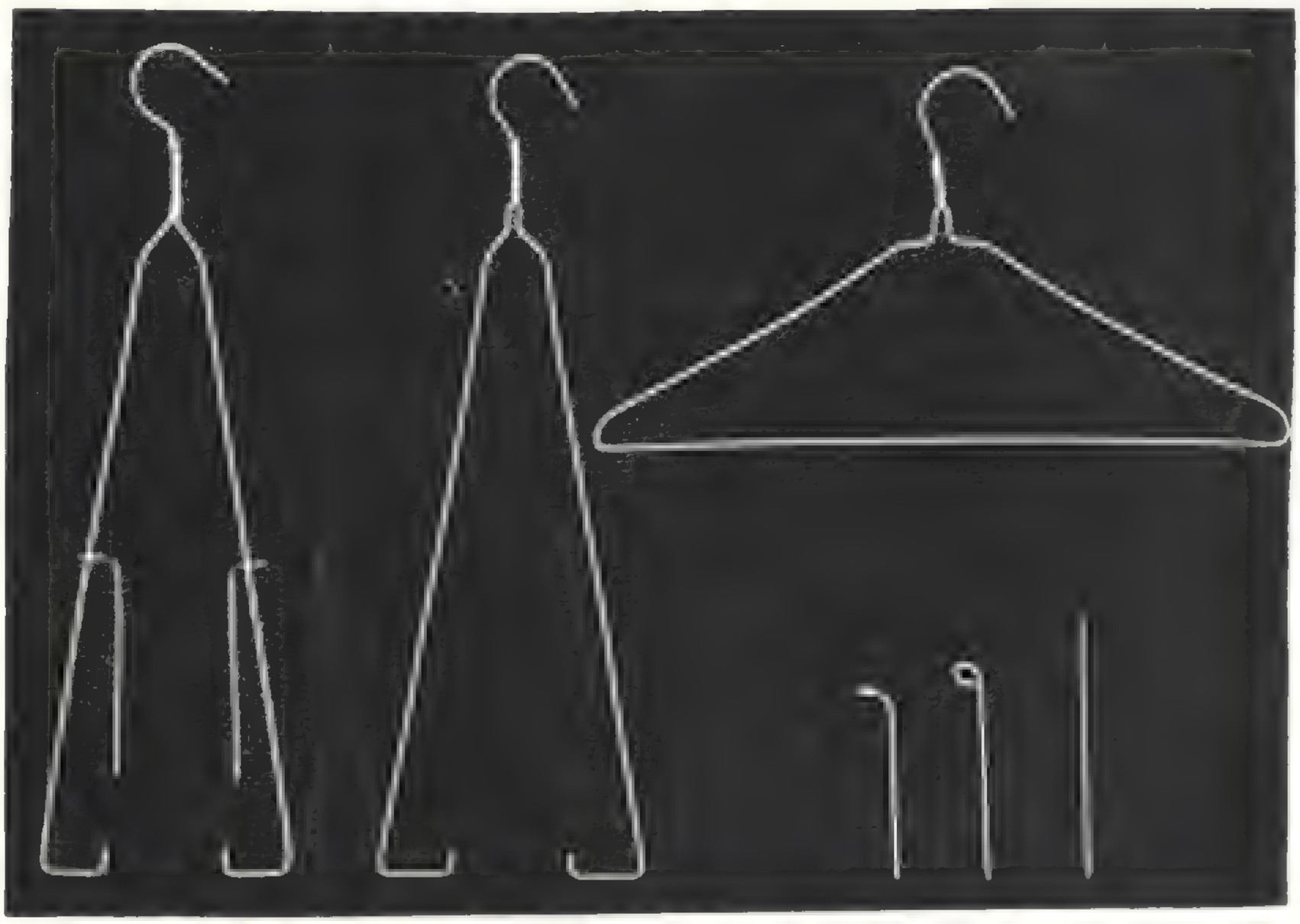
Pages and pages could be written about the very numerous stone-like "mesembs," but only a few of the remaining outstanding ones can be mentioned here. Cheiridopsis is a large genus with considerable variety both in the shape of the leaves and in the body itself. Some of the species were already known as early as 1732. *Cheiridopsis peculiaris* has the most exceptional form; *C. Caroli-Schmidtii* has finger-shaped leaves; and *C. speciosa* has velvety, grayish-green leaves and coral-red flowers with a shimmering copper luster.

Then there are the quaint Rimarias with their globular growths; the very stone-like *Didymaotus lapidiformis* with fleshy angular leaves; the attractive semi-trailing Juttadinterias; the novel *Imitaria Muirii;* the finger-like growths of *Peersia macradenia;* the dwarf, peculiarly warted and toothed Stomatiums; and a host of other very interesting forms.

L. C.

A NEW USE FOR COAT HANGERS

Those surplus wire coat hangers which the dry cleaners donate (?) to the cause may be used to advantage as hangers on which to suspend potted plants. The horizontal cross wire is severed at the middle, the two elbows straightened out, and the end of each wire bent to fit the base of the flower pot as illustrated in pl. 7, fig. 1. Short pieces of wire are then looped around each arm of the hanger and plunged into the soil in the pot to hold the



HOW TO MAKE A PLANT HANGER FROM A WIRE COAT HANGER

POT OF *ASPARAGUS SPRENGERI* SUSPENDED BY A TRANSFORMED COAT HANGER

arrangement firmly in place. Plate 7, fig. 2, shows a pot of *Asparagus Sprengeri* effectively suspended by a wire coat hanger.

If several plants are to be displayed together, it is an easy matter to make a wooden rack to support the pots and shape the wire hangers to fit the rack (fig. 1).

Fig. 1. Series of pots in a wooden rack suspended by hooks made from coat hangers.

Many plants, especially the trailing kinds, thrive better if suspended where they receive maximum sunshine and air circulation. In addition they are not so readily accessible to certain injurious insects.

D. C. F.

NOTES

Dr David C. Fairburn, Horticulturist to the Garden, spoke to the Boy Scouts of Grace Methodist Church, February 16, on "Insects."

Mr. Alfred C. Hottes and Mr. Paul T. Frese, Associate Editors, *Better Homes and Gardens,* visited the Garden recently.

Dr. Robert E. Woodson, Jr., Assistant Curator of the Herbarium, gave a talk at the meeting of the Academy of Science of St. Louis, February 23, on "Behind the Scenes of a Flora of Panama."

Dr. Hermann von Schrenk, Pathologist to the Garden, brought back from his recent trip to Guatemala a collection of various plants, chiefly conifers.

Mr. Charles H. Harrison, graduate student, University of Washington, spent several weeks in the Garden herbarium recently, working on the collection of Thelephoraceae.

Mr. A. P. Beilmann, Arboriculturist, to the Garden, gave an illustrated talk on "Trees" before the Co-operative Club, March 2, and before the St. Louis Horticultural Society, March 4.

Mr. L. P. Jensen, Manager of the Missouri Botanical Garden Arboretum, gave a talk to the members of the Eighth District of the Missouri State Federation of Women's Clubs, at the Hotel Chase, February 17, on "Roadside Improvement and Its Relation to Conservation"; and to the School Board Association of Franklin County, Mo., at the High School Auditorium, Union, Mo., March 3, on "Planting of School Grounds."

Mr. L. P. Jensen's article, "Wildlife Conservation," published in the *Missouri Magazine,* September, 1937, has been reprinted in the following publications: *Parks and Recreation,* January, 1938; *Garden Life,* January, 1938; *Gardeners' Chronicle of America,* February, 1938; and as part of the "News Letter" issued by the Missouri State Federation of Garden Clubs.

The orchid show at the Garden was broadcast over Station WEW, from 11:30 to 12:00 a. m., February 20, the first time that a broadcast has been made directly from the floral display house. It consisted of a conversation between the commentator and Mr. G. H. Pring, Superintendent of the Garden, the commentator asking questions about the plants, hybrids, mimicry, etc., and Mr. Pring explaining.

Mr. G. H. Pring, Superintendent of the Garden, has given the following talks recently: "The History of Shaw's Garden," before the Quest Club, at the Kingshighway Presbyterian Church, February 23; "The Missouri Botanical Garden, Past and Present," before the St. Louis Florists' Club, March 10; and "Plant Collecting in Panama and South America," before the Patrons' Association of the Sigel School, March 15.

The March number of the *Bulletin of the Torrey Botanical Club* (**65:** 135-166) contains an article by Dr. Robert E. Woodson, Jr., Assistant Curator of the Herbarium, and Dr. John Adam

Moore, Instructor in Botany, Huron College, Huron, S. D., entitled, "The Vascular Anatomy and Comparative Morphology of Apocynaceous Flowers."

STATISTICAL INFORMATION FOR FEBRUARY, 1938

GARDEN ATTENDANCE:

Total number of visitors	35,780

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	10
Total number of books and pamphlets donated	73

PLANT ACCESSIONS:

Total number of plants and seed-packets received as gifts	285

HERBARIUM ACCESSIONS:

By Purchase—	
Collom, Mrs. W. B.—Plants of Arizona	195
Eyerdam, Walter J.—Plants of Washington and Alaska	500
Looff, Mrs. Henry B.—Plants of Alaska	200
Rollins, Reed C.—Plants of Wyoming, Colorado and Utah	465
University of Michigan Herbarium, by C. L. Lundell—Plants of Mexico, collected by E. Matuda	233
By Gift—	
Bennett, F. L.—*Rumex maritimus* L. var. *fueginus* (Phil.) Dusén from South Dakota	1
Cutler, Hugh C.—Plants of Texas, Arizona and New Mexico	99
Hine, Mrs. K.—*Iris persica* L. from horticulture	1
Steyermark, Julian A., by R. E. Woodson, Jr.—Plants of Missouri	4
By Exchange—	
Demaree, Delzie—Plants of Arkansas	179
Hermann, F. J.—Plants of Michigan, Illinois and Wisconsin	211
Kew Herbarium—Fragments of *Senecio gelidus* Philippi	1
Lingnan University—Plants of China	4
University of California at Los Angeles, by C. C. Epling—Plants of California, Arizona, and Nicaragua	413
Total	2,506

STAFF
OF THE MISSOURI BOTANICAL GARDEN

THE GARDEN, 2315 TOWER GROVE AVENUE, ST. LOUIS, MISSOURI

GEORGE T. MOORE,
Director

HERMANN VON SCHRENK,
Pathologist

CARROLL W. DODGE,
Mycologist

JESSE M. GREENMAN,
Curator of Herbarium

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Orchid Grower

TROPICAL STATION, BALBOA, CANAL ZONE

PAUL H. ALLEN,
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REPRESENTATIVE IN EUROPE

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Hove, Sussex, England

Missouri Botanical Garden Bulletin

Vol. XXVI APRIL, 1938 No. 4

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and while virtually a private garden it was, except at certain stated times, always open to the public. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was designated by Mr. Shaw as its official title and in his will or in any of his writings he specifically referred to it as the "Missouri Botanical Garden." By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will, the immediate direction of the Garden is vested in a Director, appointed by the Board of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises 75 acres, where about 12,000 species of plants are growing. There is now in process of development a tract of land of over 1,600 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees, and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a wild-flower reservation, with the idea that possibly at some future time this may become the new botanical garden.

The Garden is open to the public every day in the year, except New Year's Day and Christmas—week days from 8:00 a. m. until sunset; Sundays from 10:00 a. m. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Place, on the Sarah car line (No. 42). Transfer south from all intersecting lines.

OSAGE ORANGE (MACLURA POMIFERA) AT THE GARDEN

Missouri Botanical Garden Bulletin

Vol. XXVI APRIL, 1938 No. 4

COMMON NATIVE TREES OF MISSOURI. III

OSAGE ORANGE (*MACLURA POMIFERA* (RAF.) SCHNEIDER)

The economic uses of a tree are generally associated with the needs of the people. Except for fuel, the Indians did not hold trees so important in their daily life as we do today. Yet there is one tree, native to a rather limited area between southern Missouri and northern Texas, which was in daily use by the Indians inhabiting these and perhaps adjoining states. In fact, the tree (*Maclura pomifera* (Raf.) Schneider) was commonly called bow-wood or Osage orange because the Osage Indians are said to have made long trips annually in search of the wood for making bows and war-clubs; and likely they used the wood or the finished product in inter-tribal trade.

Although the Osage orange played a part in the culture and economy of the early inhabitants, it is not as well known commercially as other trees of wider distribution. As a source of dye it was used by the Indians and again it gained prominence for this purpose during the World War. During the rush to the West it was made into wheel-stock. No doubt pieces of this wood, rudely fashioned to fit a broken part of a lumbering prairie schooner, outlasted the rest of the wagon, for it is in such work that its great strength and hardness becomes evident. When cut and split it has been used for fence posts and railroad ties. Of later years it has been turned into police night-sticks. When attempts were made, years ago, to start a silk industry in the United States the foliage was served to the silk-worm and proved a suitable food. Since 1869 the hedge fence has been considered a "legal fence" in Missouri, and the Osage orange was the only tree extensively

used for this purpose and specifically mentioned in the law relating to fences.

Quite apart from the importance of this tree to the people of a bygone day is its closer connection with St. Louis. It is interesting to note that it was described by Nuttall in 1818 (Genera North American Plants, page 233) from a tree growing in the garden of "Mr. Shoutou" [Chouteau] in this city. Although Nuttall mentions that the "male flowers are unknown," most of the trees in the Garden at the present time are males. Rafinesque attacked this description and insisted that he had previously proposed the name Toxylon for the genus, that Capt. Lewis had collected this plant, and that it had been sent to Pursh for identification. Nevertheless, the name *Maclura pomifera* is generally used.

The Osage orange derives the last half of its name from the fruit, which resembles a very large orange although less yellow in color. The mature fruit is the largest produced by any native tree, fully ripened specimens often weighing several pounds and measuring over six inches in diameter. In the Garden these fruits are greedily eaten by squirrels, who tumble and roll them to a place of safety and then gnaw through the outer portions to obtain the edible seeds at the very center. The accompanying illustrations show both the staminate and pistillate flowers as well as a mature specimen of the tree.

Although the Osage orange normally grows along the river courses in alluvial soil it will withstand much dry weather, as shown by its use as a hedge in the prairie states. When used as a shade tree it may be expected to grow about as fast as a pin oak. Very few insects attack the foliage, and it is not injured by borers. The branches are contorted and grow in almost any direction, so a little corrective pruning should generally be done. The wood is so hard that only the best and sharpest saw will work with efficiency; and the saw-teeth become gummed by the milky juice, requiring frequent cleaning and sharpening. However, the wood is almost wholly free of fungous attacks and remains hard and sound no matter how long the exposure or unsatisfactory the pruning paint.

Although the introduction of wire fencing has stopped the planting of new hedge fences and hastened the removal of established plantings, the Osage orange should find a place among our

Staminate flowers

Pistillate flower

FLOWERS OF OSAGE ORANGE

shade trees. The contorted branching appears bizarre when seen against the winter sky, but irregular as the branches may be they never break under the weight of sleet or pressure of wind. Even the termites have not been observed feeding on the heart-wood. A tree so staunch, so friendly to an earlier people, and so disdainful of insect enemies commends itself to us and seemingly insists upon room in our plantings, where it should be permitted to grow as a specimen.

A. P. B.

NOTES FROM THE MISSOURI BOTANICAL GARDEN TROPICAL STATION, BALBOA, CANAL ZONE

(Extracts from a letter received recently from Paul Allen, Manager of the Tropical Station)

"People living in the temperate portions of the globe usually picture the tropics as regions of constant and uniform heat, torrential rainfall, and malodorous swamps. While this description is true enough of some low-lying areas near the coasts, it by no means applies to the vast highland area of Central and South America. The rule that increased elevation has the same effect on climate as distance from the equator is vaguely familiar to most people. It is a banality to state that high mountains in the temperate zones are snow-capped, and that their tops, by reason of their increased elevation, are in the arctic zone. For some reason, this same principle becomes a wonder when applied to tropic regions, and it is with astonishment that the average person learns that lands above 4,000 feet elevation are delightfully cool, and that at about 10,000 feet the temperate zone, with many of its characteristic plants, has been reached.

"The Republic of Costa Rica, with its elevated central plateau lying roughly at 10 degrees north of the equator, offers an excellent example of these climatic belts, and shows both by native and cultivated plants the effect of the lowered temperature.

"A collecting expedition for living orchids and dried plant specimens was made for the Garden in Costa Rica during the months of December, 1937, and January, 1938, during which time most of the central highland area was covered. By far the highest as well as one of the most accessible mountains of this area is the Volcano

Irazu, which dominates the entire plateau with its vast bulk. The elevation of 11,322 feet is topped by only two others near the Panamanian border, which, unfortunately, are almost impossible to visit. Irazu, in spite of its size and the fact that it is one of the most conspicuous features of the landscape from San Jose, the capital, is not a spectacular type of volcano. It has no billowing cloud of smoke, and is not the perfect cone sometimes seen in volcanic mountains. It is regarded by the native Costa Ricans with affection mixed with considerable awe, since it was the source of the terrible series of earthquakes that completely destroyed the city of Cartago in 1910.

"Weather about the summit is quite capricious, with storms and clouds alternating with perfectly clear skies, often within a few hours. We were very desirous of securing a collection of plants from the peak, but were constantly discouraged by the natives of San Jose, who declared the trip to be well nigh impossible and enlarged on the possibilities of bad weather. We finally selected a clear morning, and contracted with a chauffeur to carry us as far as the Sanitorio and to return for us late in the day.

"We were delighted to find that considerable work had been done by the Government on the trail, which was in excellent condition. Evidently there is some ruling here to prevent the dragging of logs down the roads, a custom which has gone far toward ruining the trails up the Volcano Poas. The lower flanks of the mountain are largely under cultivation, although very little is in coffee. Most of the fields were in potatoes, corn, and barley. We saw many men plowing with teams of oxen, a refreshing sight to us since plowing is not practiced in the lowlands. These plowed fields were generally being sown to wheat.

"Between 8,000 and 9,000 feet elevation is the dairy region, with very fine-looking cattle. Numerous ox carts were toiling up the road with supplies for these. The milk is carried out on horseback in curious metal containers fitted to the saddle. The laborers' shacks often had quite interesting collections of flowers about the dooryards, one of which in particular included petunias, snapdragons, calla lilies, Dianthus, *Iris germanica,* rambler roses, California poppies, phlox, and many other things usually associated with northern gardens. There were very fine hedges about twelve

feet tall of the beautiful angel's trumpet, *Datura suaveolens,* which is not often seen outside the southern states in continental United States.

"At about this same elevation is found the remains of what was evidently an extensive oak forest. The trees often reach the neighborhood of ninety feet, and are fine specimens. Several species are present, many of the smaller ones loaded with masses of a broad-leaved mistletoe with very showy orange flowers. The oaks are apparently fighting a losing battle, however, since the hand of the cultivator is heavy on the land. The only species we found in fruit was evidently *Quercus irazuensis,* which in former times was said to form pure stands at this elevation. Fallow fields along the way were full of blue lupines, dandelions, and the common ageratum used in St. Louis for outdoor bedding plants. The oak belt ends very abruptly at about 9,500 feet. The trees at this elevation are torn to pieces by the violent winds, of which we saw much evidence in those felled across the trail. Very near to this same elevation were many clumps of a medium-sized bamboo, all dead, which may or may not have been due to the end of a flowering cycle.

"The trail sides above this oak belt for some distance are made bright by quantities of tall yellow-flowered *Senecio Oerstedianus,* whose very attractive rough leaves showed silvery undersides when blown in the wind. Mixed with these were many scarlet *Castilleja irazuensis,* much resembling the Rocky Mountain species. Very soon a curious dead forest of small trees is reached, through which the cinder trail winds its ghostly way. These trees are of a rather uniform height of perhaps twenty feet, and have the stark appearance of fire-killed timber in the West. Since many of them were sprouting from the old trunks, we at first thought that perhaps they were relics of a comparatively recent eruption, but have found since that they were evidently in this condition in 1847 when the botanist Oersted visited the Volcano. They seemed to be *Arctostaphylos ledifolia,* the species which is so common in high elevations here. We were surprised to encounter a great deal of a species of Smilacina, much resembling ours at home but stouter. Mixed with it was some very curious vine, similar to the amaryllidaceous Bomareas, with dark red clusters of flowers which

clambered up and over the dead trunks. *Spiraea argentea* we found to be quite common, although not reaching as high on the slopes as some of the Ericaceae.

"Fine views were had here of the Cordillera of Talamanca stretching toward the Panamanian line, with the famous Cerro de la Muerte, where poorly equipped lowlanders are reputed to have frozen to death in crossing the pass. Far to the south the peak of Chirripo Grande, the highest point in this portion of Central America, could just be seen breaking through the clouds. The last ridge of the trail was reached two and a half hours after leaving

HIGHEST AND EVIDENTLY OLDEST OF THE THREE CRATERS OF THE VOLCANO IRAZU, ABOUT 10,800 FEET ALTITUDE

the Sanitorio, with the weather quite clear but windy and very cold. The temperature was found to be 43 degrees in the shade. Almost the entire vegetation consists of *Arctostaphylos ledifolia,* about shoulder high, and small stunted bushes of *Pernettya coriacea.* This last resembles greatly the common huckleberry, but curiously a sort of drunkenness and paralysis ensues from eating any quantity of the fruit.

"The summit at present is broken into three principal craters, two of them evidently quite old. The newest of the three is enormous, quite deep, more or less active, and entirely bare of any sort of vegetation on its inner walls. All three contain small shallow lakes of varying size. Of the one in the upper crater, our

small guide told us the encouraging news that a man and horse had been lost in the mud flats about its edge. We gave it a wide berth, since the only plants at all near were a species of grass which could be had elsewhere.

"A great deal of the timber has been destroyed in the belts where orchids would normally have been found, but a fairly representative collection of the present flowering plants of the peak was secured, and has been sent to St. Louis for further study."

THE WHITE REDBUD FOUND AGAIN

Ed. A. Alt, Jr., a fourth-grade pupil at the Oakfield District School, discovered a wild white redbud, April 5, 1938, on his father's farm at Pacific, Mo. The tree is located on the south slope of a wooded hill, and is about eight feet high and three inches in circumference. It appears to be the outgrowth of an older, much larger tree, the remains of whose trunk is now barely discernible above the surface of the ground. On finding the tree, Junior informed the Missouri Botanical Garden Arboretum at Gray Summit, which asked for a sample. Immediately it was sent—genuine, creamy-white redbuds.

As far as is known, this is only the second time that *Cercis canadensis* var. *alba* has been found outside of cultivation. All of the white redbuds in various nurseries and gardens throughout the country have originated from the "sport" found by John Teas, Carthage, Mo. This was some time previous to 1903, when a small plant was received at the Garden for trial. Seventeen years later all the original stock of white redbud from Teas Nursery was acquired by the Garden.

MRS. MARTIN BAGBY.

NOTES

Dr. Edgar Anderson, Geneticist to the Garden, broadcast over Radio Station KSD, March 30, on "How Forsythia First Came to This Country."

Dr. David C. Fairburn, Horticulturist to the Garden, has an article in the April issue of *The Modern Hospital Magazine*, entitled "Softening Bleak Exteriors."

Mr. G. H. Pring, Superintendent of the Garden, gave an illustrated lecture before the Quincy Garden Club, Quincy, Ill., April 12, on "Designing and Planting Gardens."

The Herbarist, a Publication of the Herb Society of America, for 1938 (4: 15-16) contains an article by Dr. Edgar Anderson, Geneticist to the Garden, entitled "Mints and Microspores."

Mr. L. P. Jensen, Manager of the Garden Arboretum, spoke before the Manchester School Association, at Manchester, Mo., March 21, on "The Relation of Gardening to Community Life."

Mr. Ladislaus Cutak, in Charge of Succulents at the Garden, is the author of an illustrated article, "Succulents at the Missouri Botanical Garden," in the March number of *Desert Plant Life*.

Mr. L. P. Jensen, Manager of the Garden Arboretum, attended the meeting of the Board of Directors of the Missouri State Federation of Garden Clubs, at the St. Louis Arena, March 30.

Dr. Carroll W. Dodge, Mycologist to the Garden, presented a paper before the Eastern Missouri section of the Society of American Bacteriologists, April 12, on "Some Effects of Carcinogenic Substances on Yeasts."

In a series of interviews on gardening and horticulture over Radio Station KMOX, Dr. George T. Moore, Director of the Garden, spoke on "The Value of the Flower Show," March 23, and Dr. Hermann von Schrenk, Pathologist to the Garden, on "Gardens for Private Estates," March 25.

Mr. Ladislaus Cutak, in Charge of Succulents at the Garden, gave an illustrated talk before the Botany 101 class of Washington University, March 23, on "Exploring Southwestern Deserts for Cacti"; and before the senior group of the Holy Name Society, St. Margaret's Church, April 26, on "Vagabonding in the Southwest."

Recent visitors to the Garden library include Miss Phyllis Cook and Miss Margaret Kaeiser, graduate students in botany, University of Illinois, Urbana; Dr. Norman Fassett, Assistant Professor of Botany, University of Wisconsin, Madison; Dr. Harry J. Fuller, Assistant Professor of Botany, University of Illinois, Urbana; Dr. Robert W. Webb, Principal Cotton Technolo-

gist, Bureau Agricultural Economics, U. S. Dept. Agr., Washington, D. C.; Dr. H. S. Conard, Head Dept. Botany, Grinnell College, Grinnell, Iowa; Mr. Ralph E. Rawlings, student in botany, University of Arkansas, Fayetteville, Arkansas; Mr. Norman Butterfield, graduate student, Purdue University, Lafayette, Ind.

STATISTICAL INFORMATION FOR MARCH, 1938

GARDEN ATTENDANCE:

Total number of visitors	29,975

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	42
Total number of books and pamphlets donated	167

PLANT ACCESSIONS:

Total number of plants and seed-packets received as gifts	2,134

HERBARIUM ACCESSIONS:

By Purchase—	
Botanical Garden, Berlin-Dahlem—Plants of Ecuador, collected by A. J. F. Schimpff	43
Degener, Otto—Plants of Hawaii	37
Eyerdam, Walter J.—Plants of Washington	210
University of California Botanical Garden—Plants of South America	109
Wynd, F. Lyle—Plants of Mexico	107
By Gift—	
Barkley, Fred A.—*Limosella aquatica* L. from Montana	1
Clokey, Ira W., by R. E. Woodson, Jr.—Plants of Nevada	4
Cutler, Hugh C.—*Chilopsis linearis* (Cav.) Sweet, from Texas	1
Pring, George H.—Plants of horticulture	2
Rosengurtt, Bernardo, by R. E. Woodson, Jr.—Plants of Uruguay	10
University of California Herbarium—*Fischeria calyculata* Dcne. from Peru	1
von Schrenk, Hermann—Plants of Guatemala	68
By Exchange—	
Barkley, Fred A.—Plants of Montana	36
Clokey, Ira W.—Plants of California and Nevada	3,210
Demaree, Delzie—Plants of Arkansas, Oklahoma, and Colorado	228
U. S. National Museum—Lichens of Venezuela	6
By Transfer—	
Anderson, Edgar—Plant of horticulture	1
Beilmann, A. P.—Plant of horticulture	1
Lodewyks, Maude C.—Plant of horticulture	1
By Field Work—	
Allen, Paul H.—Plants of Panama, approximately	450
Total	4,526

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MISSOURI BOTANICAL GARDEN BULLETIN

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GUIDE

TO THE

SUCCULENT PLANT COLLECTION

OF THE

MISSOURI BOTANICAL GARDEN

SELENICEREUS PTERANTHUS
(night-blooming cereus)

BY

LADISLAUS CUTAK

ONE OF THE SUCCULENT HOUSES AT THE GARDEN

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GUIDE TO THE SUCCULENT PLANT COLLECTION OF THE MISSOURI BOTANICAL GARDEN

Introduction.—With an enthusiasm born of intimate acquaintance, the author has attempted an evaluation of the desert plant life now housed in two greenhouses at the Garden. In the past decade there has been shown an intense interest in all types of desert plants, and there is no denying that they have at last attained a permanent place on the horticultural menu. The collection at the Garden, as it stands today, represents one of the largest under glass in America, numbering well over 1000 species and varieties.

It is the aim of this article to list all the named desert plants in the collection, so that the representatives of this large group may be readily accessible to visitors and the scope of material realized by all. The naming of plants in most large gardens is often unavoidably neglected, except in such cases where groups have been or are being critically studied. At the Garden a concerted effort has been made to label each plant according to the most common system of nomenclature, and the spelling of names is consistent with that of the "Index Kewensis."

The visitor will note that a small square or oval metal tag is affixed to each plant. It bears the botanical name, the geographical range, and a key number by which the history of the specimen can be traced in the accession books kept on record at the Main Gate. Thus, for example, the label "Leptocereus assurgens, Cuba, 112-37-4" means that the habitat of *Leptocereus assurgens* is Cuba. The first part of the key number (112) denotes that the Atkins Institution was the 112th party to donate or exchange plants with our

institution, the middle number (37) indicates the year, 1937, and the last number of the key (4) is the plant number. Besides this metal tag, some of the more interesting plants are provided with a green celluloid label bearing information couched in as few words (40 is the limit) as possible.

Succulents as desert plants.—Several types of plants make their home in deserts: One kind comes up with occasional rains and completes its life cycle within a relatively short time; the non-succulent type has a root system which extends deep into the substratum where moisture always lurks; and there are those with thickened bodies in which water is stored to be used during periods of drought. The cacti and spurges are the most characteristic of this last group, and are of the greatest interest to most people. Frequently they are classed as "freaks of nature," and indeed many deserve this appellation because of their grotesque appearances.

What is a succulent? The term is derived from the Latin meaning "fleshy" or "juicy," and is applied to plants possessing greatly thickened leaves or stems for water-storage. However, the expression is used more or less broadly. Bulbous plants are generally excluded, although there is a certain amount of succulency involved in them. Begonias, geraniums, and Wandering Jews have a succulent tendency, but among collectors they are not regarded as succulents. Yuccas, dasylirions, and agaves are not "succulent" in the purest sense although xerophytic in habit, but common usage has always associated them with this group and they are generally accepted as members. The most notable families with succulent peculiarities are the cactus (Cactaceae), orpine (Crassulaceae), fig-marigold (Aizoaceae), and the spurge (Euphorbiaceae). Other families containing a high percentage of succulent plants are the lily (Liliaceae), purslane (Portulacaceae), milkweed (Asclepiadaceae), and amaryllis (Amaryllidaceae). A few succulents can also be found in the grape family (Vitaceae), the geranium (Geraniaceae), the daisy (Compositae), and Dioscoraceae.

The grotesque shapes of many succulents are the direct result of the hard-fought struggle for mere existence. For ages the sun has beat down mercilessly on these plants and water has fallen less and less frequently, and the succulents have had to adjust themselves to such conditions if they were to survive. The cacti

are possibly the highest developed examples of succulent desert plants, with the spurges running a close second.

In the cactus family conservation has advanced so markedly that leaves are cast off entirely (except in such tropical genera as Pereskia, Pereskiopsis, and Quiabentia) or are reduced to small awl-shaped bodies which wither and fall after a short time, as in the Opuntieae tribe. In the more complex Cereiae tribe the leaves are absent, except in rare instances where they appear rudimentary on the young growth. Furthermore, cactus plants, especially those of the spheroid and columnar types, present the least surface exposure to the rays of the sun, and are further guarded by a waxy epidermis and abundance of radiating spines.

Most succulents of the spineless variety, as crassulas, echeverias, mesembryanthemums, etc., have thickened leaves, gelatinous juices, and other protective devices in the form of closely set hairs and waxy secretions, which prevent excessive evaporation and conserve a constant water supply. Some of the fig-marigolds and haworthias, in order to escape the fierce African sun, have learned to bury themselves in the sand, except for the flat translucent tops and leaf tips which act as "windows" and permit light to reach the underground parts. Because these plants have made radical adjustments in their mode of living, they have been enabled to maintain themselves as the dominating plant group in the desert regions.

Succulents as house plants.—A good majority of succulent plants, and there are several thousand species to choose from, make excellent pot plants for the home. Even the monstrously large types can be utilized for this purpose if seedlings or cuttings are used. Whenever a tall plant becomes too large or heavy for handling easily, it can be topped or cut back. This paves the way for adventitious shoots to develop, which when of sufficient size can be taken off the maternal plant and grown on as individual specimens. Other large succulents, such as the agaves, aloes, etc., produce numerous suckers or offshoots which can be severed from the adult plant and grown in smaller pots.

Because most succulents possess a leather-like epidermis which limits the evaporation of the plant juices, they are able to resist the dry atmosphere of living-rooms far better than other types of plants. Many can be grown out of doors in the northern states in

summer, and several hundred species, the sedums, sempervivums, talinums, certain cacti, and the like, are hardy enough to withstand our winters. There is no limit to what can be grown in sunrooms anywhere.

Succulents have not only found appreciative gardeners in Europe and America, but in all corners of the world. Frequently people are under the impression that cacti and their succulent allies thrive without any attention whatsoever, but that conception is highly erroneous. Truly, they require a minimum of care after being thoroughly established, but to say they will thrive in the home without water and sunlight is absurd. Several articles on the culture of cacti have been written in various issues of the BULLETIN (Feb., May, and Sept., 1933, May, 1934, Sept., 1935, Oct., 1936, Nov., 1937, March, 1938), and the reader is referred to them for further information.

The working man in the humblest home can grow as fine plants as the man with greenhouse facilities. A sunny window is the primary requisite, and it is surprising how many excellent succulents can be cultivated in such a cubby-hole. Each group of succulents, whether of the cactus, lily, or spurge family, includes a host of interesting plants that merit a trial in the house. The cacti have attracted more widespread attention than all the rest of the succulents, because they possess the greatest range in form and size. The spurges, especially those that strikingly resemble the cacti, constitute another popular group, while the stapeliads, originating in the African deserts, are undoubtedly among the greatest curiosities of plant life. The aloids, comprising such genera as Aloe, Apicra, Gasteria, and Haworthia, vary in size from tiny specimens to large trees and generally are not difficult to grow. The Haworthias are the most attractive of the succulent lilies, resembling closely the "hen-and-chicken plants," and are well adapted for window culture. Recently, the stemless fig-marigolds, commonly alluded to as "living stones and pebble plants," have become very popular with collectors of succulents. Hundreds of these tiny mimic plants can be grown in the space of an average window, and require the least amount of care. Of the orpines, the kalanchoes, crassulas, bryophyllums and rocheas seem to be much favored. *Kalanchoe Blossfeldiana* and *K. Kirkii* have become two of the outstanding colorful pot plants of the winter flowering season.

ASCLEPIADACEAE (MILKWEED FAMILY)

The large family of milkweeds contains some of the most intriguing plants of the succulent world. These lend themselves admirably for pot culture and are of easy growth. The most conspicuous are the stapelias and their allied genera, consisting of over 500 species and varieties. They are mostly low-growing, leafless, stout-angled or thick-cylindric, fleshy herbs, growing in clusters. The flowers are five-pointed and star-like, ranging in size from minute to sometimes a foot in diameter, luridly spotted, dotted, streaked, or lined, and often covered with silky hairs. Unfortunately, they possess an unpleasant odor, yet this does not curb their popularity in the least. The members of the genus Ceropegia have most peculiarly shaped flowers, resembling unique lanterns. The plants have a twining habit, making them suitable for hanging baskets and vases, and are very easy to grow. The most desirable are the following: *C. Woodii,* with long graceful stems and abundant, small, heart-shaped, fleshy, mottled leaves; *C. Sandersonii,* with curious, greenish, parachute-like flowers; and *C. stapeliaeformis,* with thick, grayish-green, twining stems and unusual flowers, unlike any other ceropegia. The succulent "wax plant," *Hoya carnosa,* has always been a great favorite, especially when in flower.

Our stapeliad collection is the result of several generous gifts received from Alain White and Boyd L. Sloane, authors of the three-volumed monograph, "The Stapelieae" (1937), to which the reader is recommended for detailed descriptions of the following species:

CARALLUMA
armata
Baldratii
Burchardii
Burchardii var. *maura*
carnosa
europaea
Hahnii
hesperidum
Knobelii var. *Langii*
Lugardi
lutea
Marlothii
melanantha
Munbyana
Nebrownii
Nebrownii var. *pseudo-Nebrownii*
piaranthoides
ramosa
retrospiciens
umdausensis
venenosa

DIPLOCYATHA
ciliata

DUVALIA
angustiloba
Corderoyi
elegans
Emiliana
hirtella var. *obscura*

maculata var. *immaculata*
modesta
polita
polita var. *transvaalensis*
reclinata var. *angulata*

ECHIDNOPSIS
cereiformis
cereiformis var. *obscura*
Framesii
serpentina

HOODIA
Pillansii

HOODIOPSIS
Triebneri

HUERNIA
brevirostris
clavigera
Gibbsiae?
Herrei
hystrix
insigniflora
keniensis
keniensis var. *nairobiensis*
Kirkii
Levyi
Loeseneriana
longituba
macrocarpa
macrocarpa var. *cerasina*
macrocarpa var. *flavicoronata*
macrocarpa var. *Penzigii*
ocellata
oculata
Pillansii
primulina
primulina var. *rugosa*
quinta
reticulata
Schneideriana
stapelioides
Thureti
transvaalensis
Whitesloaneana
zebrina

HUERNIOPSIS
atrosanguinea
decipiens

PECTINARIA
asperiflora
saxatilis

PIARANTHUS
comptus
disparilis var. *immaculatus*
foetidus
Framesii
globosus
Pillansii

STAPELIA
ambigua var. *fulva*
angulata
asterias var. *lucida*
bella
cantabrigiensis
charybdis
clavicorona
comparabilis
conformis
deflexa
deflexa var. *atropurpurea*
Desmetiana
Dummeri
Engleriana
flavirostris
gemmiflora
Gettleffii
gigantea
glabricaulis
glanduliflora
Hanburyana
hirsuta
hirsuta var. *affinis*
hirsuta var. *unguipetala*
kwebensis var. *longipedicellata*
Leendertziae
maculosoides
Margarita
mutabilis
nudiflora
pasadenensis
pedunculata
Peglerae
Pillansii
pulchella
pulvinata
radiata?
rufa
Schinzii
semota
variegata
variegata var. *bufonia*
variegata var. *picta*
variegata var. *planiflora*
verrucosa

STAPELIANTHUS
Decaryi

FOLLICLES OF STAPELIA EMITTING SEED

HOYA CARNOSA IN BLOOM

TAVARESIA
angolensis
grandiflora

TRICHOCAULON
columnare
piliferum

(OTHER ASCLEPIADS)

CEROPEGIA
Barkleyi
debilis
Sandersonii
stapeliaeformis
Woodii

HOYA
carnosa

SARCOSTEMMA
australis
viminale

AMARYLLIDACEAE (AMARYLLIS FAMILY)

The succulent, or rather xerophytic agaves, are perhaps the dominating plants in many American waste places. They range in size from the tiny *Agave parviflora* of southern Arizona deserts to the extremely large *A. atrovirens* of central Mexico. Many of the species were of great economic importance to the aboriginal Indian, and today they are used for decorative purposes in tropical gardens and conservatories. The most useful agaves are the "mescal plants," from which several intoxicating liquors are manufactured. When the plant is about to bloom, the flowering bud is cut away, the sap or "honey water" collecting in the cavity formed. Each tapped plant produces an average of ten to fifteen pints of aguamiel a day, which is gathered by the peons in various containers and then taken to the pulqueria, where it is converted into the national drink, called pulque.

Aside from the liquor, the agaves have had other utilitarian purposes. The tough fiber contained in the leaves has been used in making lassoes for roping animals, mattresses and clothes; the dry leaves were employed in thatching the roofs of huts; the juice was applied to sores; the sharp end spines were utilized for needles; the bruised leaves afforded a paste from which paper similar to the Egyptian papyrus was manufactured; and the cores, when properly cooked, were palatable and nutritious food. In short, the maguey was everything to the aborigines before white man's ingenuity made its appearance.

Since the nomenclature of these plants is very confused, the system adopted by Alwin Berger has been adhered to almost exclusively in the following list:

AGAVE
albicans var. *medio-picta*
americana
americana var. *marginata-aurea*
atrovirens
attenuata

aurea
bracteosa
cacozela
chiapensis
chrysantha
cochlearis
decipiens
elongata
Ferdinandi-Regis
ferox var. *Bonnetiana?*
filifera
fourcroydes
Franzosini
Funkiana
Ghiesbreghtii
gracilipes
heteracantha
horrida
indagatorum
ingens var. *picta*
intermedia?
lechuguilla
lophantha
macrantha
Milleri?
mitriformis
Murpheyi
oblongata
Palmeri
Parryi
parviflora
pruinosa
rigida
Roezliana
Salmiana
Schottii
sisalana
striata
Toumeyana
Treleasii
vestita
Victoriae-Reginae
virginica

FURCRAEA

Bedinghausii
Cabuya var. *integra*
Humboldtiana
inermis?
Lindeni
Selloa var. *marginata*
tuberosa

EUPHORBIACEAE (SPURGE FAMILY)

This is one of the large botanical families, members of which are very variable in habit and form and scattered throughout all parts of the world. Some are herbs, some shrubs and trees, but the most interesting are the succulent, cactus-like types found chiefly in Africa, Arabia, Madagascar, Canary Islands, and India. The succulent spurges at the Garden are well represented, and interspersed in the collection are a few, less fleshy members to show the great variability found in this fascinating, yet the least understood, plant group.

All euphorbias are well supplied with milky juice, which is highly poisonous to animals in many instances. Most of the spurges are of no economic value; yet a few produce drugs, some are used as stock feed, and others, *E. Intisy,* for instance, yield excellent rubber. Several species have been extensively used for fish poisons. The macerated branches were thrown into a stream, their toxic juices aiding in stupefying the fish, in which condition they were easily picked up.

Since a great majority of succulent spurges inhabit arid regions similar to those occupied by the American cacti, their mode of culture is identical. Good drainage is essential at all times, with water sparingly applied during the dormant season. Many of the fleshy euphorbias in our collection have been grown from seed and cuttings donated by Dr. Leon Croizat, the euphorbia specialist now at the Arnold Arboretum.

EUPHORBIA

abyssinica
aggregata
antiquorum
antisyphilitica
aphylla
Barnhartii
biglandulosa
Bivonae
bubalina
bupleurifolia
caducifolia
canariensis
candelabrum var. *Erythraeae*
Cattimandoo
cereiformis
clandestina
Clava
coerulescens
conspicua
Cooperi
Deightonii
dendroides
dulcis
Echinus
fasciculata
fimbriata
Franckiana
fulgens
Gerardiana
globosa
Gorgonis
grandicornis
grandidens
Hermentiana
hottentota
inermis
ingens
Intisy
lactea
lactea cristata
lateriflora
Ledienii
Lemaireana
lophogona
mammillaris
mauritanica
Morinii?
Muirii
multiceps
Myrsinites
neriifolia
neutra
Nivulia
officinarum
orabensis
ornithopus
pentagona
pentops?
Pfersdorfii?
pilulifera
piscatoria
pseudocactus
pseudoglobosa
pteroneura
pulcherrima
ramipressa
Regis-Jubae
Reinhardtii
resinifera
Rothiana
Royleana
Schimperi
similis
splendens
stapelioides?
stellaespina
stolonifera?
tenuirama
Terracina
tetragona
Tirucalli
virgata
virosa

Welwitschii
Wilmanae
xylophylloides
PEDILANTHUS
aphyllus?
macrocarpus
Smallii
tithymaloides
SYNADENIUM
arborescens
Grantii

LILIACEAE (LILY FAMILY)

Of the many succulent or near-succulent genera forming a part of the very colorful lily family, the outstanding are Aloe, Gasteria, Haworthia, and Yucca. The propagation of these is very simple and easy. Almost every species makes an abundance of off-shoots or underground runners which give rise to new plants that may be detached already rooted. Seeds of most species furnish a ready means of increase, and in many cases individual leaves, if placed in sand or on sandy soil, will sprout young plants.

Succulent lilies, especially the aloes, will thrive in almost any kind of well-drained soil. Many varieties will withstand as much abuse as the common sansevieria or aspidistra, and for this reason make excellent house plants. During the growing season, water should be supplied more frequently than is ordinarily given to spurges and cacti. In warmer regions these plants can be grown outdoors all the year round, the taller and bushy types making excellent ornamental material in the drier portions of gardens or hillsides.

The haworthias are the smallest of the succulent lilies and the darlings of the family. Gasterias are highly decorative plants possessing conspicuous slender racemes of gracefully pendent, highly colored flowers.

ALOE
abyssinica
acutissima
africana
andringitrensis
arborescens
arborescens var. *Milleri*
aborescens var. *natalensis*
arborescens var. *pachythyrsa*
arborescens var. *viridiflora*
borziana
brevifolia var. *serra*
Broomii
Brunnthaleri
bulbillifera
caesia
capitata var. *cypolinicola*
capitata var. *typica*
Chabaudii
Chludowii
ciliaris
commutata
Davyana
de Laetii (hybrid)
deltoideodonta
divaricata
elegans
eru

eru var. *maculata*
ferox
glauca
globulifera
Greatheadii
humilis
Johnstoni
Krapohliana
lateritia
latifolia
lineata
littoralis
longibracteata
macrocarpa
microstigma
mitriformis?
Muirii
nobilis
Nowotnyi
obscura
Paxii
Pienaarii
plicatilis
pluridens
pratensis
pretoriensis
pseudopicta
rubro-lutea
runcinata
Salm-Dyckiana
Salm-Dyckiana var. *fulgens*
saponaria
saponaria var. *lutea-striata?*
Schimperi (hybrid)
Schladenowii?
Schlechteri
spinosissima
spuria
Sterndnerii?
Straussii
striata
striata hybrida
succotrina
succotrina var. *saxigena*
supralaevis
supralaevis var. *erythrocarpa*
supralaevis hybrida
tenuior
Thraskii
Vahombe
variegata
vera
Viguieri
Wickensis
Winteri (hybrid)
Ysalensis
zebrina

APICRA
congesta
foliolosa

BOWIEA
volubilis

DASYLIRION
acrotrichum
cedrosanum
quadrangulatum
serratifolium
Wheeleri

DRACAENA
Draco

GASTERIA
acinacifolia
carinata
Croucheri
elongata
linguaformis?
maculata
nigricans
nitens
nitida
subverrucosa
trigona
verrucosa
vittata

HAWORTHIA
albicans
angustifolia
arachnoides
aristata?
asperula
attenuata
Cooperi
cymbiformis
Dielsiana
fasciata
margaritifera
pilifera
Radula
Reinwardtii
rugosa
setosa?
Taylorii
tortuosa var. *pseudorigida*
turgida
viscosa

THE TRUE ALOE *(Aloe vera)* GROWING IN THE SOUTH AFRICAN HOUSE AT THE GARDEN

SEA URCHIN CACTUS

HESPERALOE
parviflora
LOMATOPHYLLUM
orientale
NOLINA
longifolia
microcarpa
recurvata
SAMUELA
carnerosana
SANSEVIERIA
cylindrica
cylindrica var. *patula*
subspicata
trifasciata
trifasciata var. *Laurenti*

YUCCA
aloifolia
aloifolia var. *marginata*
arkansana
australis
baccata
Baileyi
elata
elephantipes
filamentosa
glauca
gloriosa
Harrimaniae
macrocarpa
rigida
rostrata

(To be concluded in the June Bulletin.)

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GUIDE TO THE SUCCULENT PLANT COLLECTION OF THE MISSOURI BOTANICAL GARDEN

(Continued from the May Bulletin)

CRASSULACEAE (ORPINE FAMILY)

Most members of this interesting family are more or less succulent. The sedums are the most common and evidently are the first plants thought of when a rock garden is planned. Chiefly these are thick-leaved perennials, just a few inches high and forming dense turf-like mats over rocks and soil. Like the sempervivums, they are generally winter-hardy and for that reason are excellent subjects for the gardens of temperate climates. In the sub-tropic regions the orpines attain the stage of sub-shrubs or shrubs and therefore are valuable for ornamentals in conservatories and gardens. With few exceptions, they are able to endure intense drought.

Of the tender sempervivums, the genus Aeonium is possibly outstanding, comprising about thirty-six species. In Mexico and the Southwest, the orpines are represented by the very attractive Echeveria, Dudleya, Stylophyllum, and several other genera. These plants grow in a more or less rosette fashion, giving the appearance of small cabbages. In Africa and Madagascar, the orpines number several hundred species, most of which are handsome, easy of culture, and make excellent pot plants. The most interesting genera are Kalanchoe, Bryophyllum, Cotyledon, Crassula, and Rochea.

AEONIUM
arboreum
atropurpureum
Haworthii
Saundersii?
Tournefortii?
ADROMISCHUS
maculatus
triflorus
BRYOPHYLLUM
calycinum
crenatum
daigremontianum
tubiflorum
BYRNESIA
Weinbergii
COTYLEDON
ausana
coruscans
decussata
orbiculata
papillaris
undulata
CRASSULA
arborescens
cultrata
decipiens
lactea
lycopodioides
monticola
multicava
pulvinata
perforata
pseudolycopodioides
rubicunda
tetragona
trachysantha
CREMNOPHILA
nutans
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Collomae
ECHEVERIA
agavoides
carnicolor
crenulata
Desmetiana
elegans
expatriata
gibbiflora var. *metallica*
glauca
globosa
Hoveyi
kewensis
microcalyx
nodulosa
pubescens
simulans
stolonifera
Whitei
GRAPTOPETALUM
Orpetii
GREENOVIA
dodrentalis
KALANCHOE
aleurodes
Aliciae
aromatica
beharensis
Blossfeldiana
carnea?
crenata
Engleri
Fedtschenkoi
flammea
glaucescens
hirta
Kirkii
laciniata
marmorata
orgyalis
Petitiana
rotundifolia
somaliensis
spathulata
thyrsiflora
tomentosa
velutina
Welwitschii
KITCHINGIA
mandrakensis
uniflora
LENOPHYLLUM
texanum
OLIVERANTHUS
elegans
ROCHEA
coccinea
falcata
SEDUM
Adolphii
amecamecanum
arborescens?

confusum
diffusum
dendroideum
guatemalensis
humifusum
multiceps
Palmeri
Sieboldii
Stahlii
Treleasei
Winkleri

SEMPERVIVUM
arachnoideum
arachnoideum var. *glabrescens*

SINOCRASSULA
yunnanensis

"GOLDEN BARREL" CACTUS PLANTED AMONG OTHER SUCCULENTS

CACTACEAE (CACTUS FAMILY)

The Cactaceae, comprising over 1500 species, is the most remarkable and most outstanding of all the succulent families. Cacti are indigenous to the western hemisphere, but their popularity has carried them into nearly every land on the globe. In the drier parts of Africa, Australia, Asia, and Europe, they have

escaped from cultivation and have established themselves so securely that they can hardly be distinguished from the indigenous flora. They are generally easy of culture, and because of their peculiar shapes are greatly sought after by collectors of bizarre plants. The flowers of certain species can hardly be equalled in beauty by those of any other plant, not even the orchid. The

A CACTUS BED

Garden cactus collection has recently been greatly augmented by several generous gifts from the Pirtle boys of the Rio Grande Valley Cactus Garden; while a nearly-complete set of Arizona cacti has been received from Mr. R. H. Peebles of Sacaton, Arizona.

The cactus family is divided into three distinct tribes and over one hundred genera. The Pereskieae tribe, numbering about

twenty species, is assumed to be the most primitive and more closely resembles leafy shrubs and trees than it does members of its own family. The nine genera of the Opuntieae tribe display the evolutionary trend from the preceding group. The third tribe, Cereiae, is the most complex and contains the darlings of the family, ranging from the dwarf to the gigantic. The system of nomenclature used by Britton and Rose in their monumental work "The Cactaceae" is followed here, except in few instances deemed necessary by present rules.

ACANTHOCEREUS
floridanus
pentagonus
ANCISTROCACTUS
megarhizus
Scheeri
APOROCACTUS
flagelliformis
ARIOCARPUS
fissuratus
Kotschoubeyanus
retusus
trigonus
ARROJADOA
rhodantha
ASTROPHYTUM
asterias
capricorne
myriostigma
myriostigma var. *tamaulipensis*
ornatum
CARNEGIEA
gigantea
CEPHALOCEREUS
albispinus
Arrabidae
atroviridis
Brooksianus
chrysacanthus
colombianus
cometes
Deeringii
euphorbioides
Gounellei
hapalacanthus
leucocephalus
leucostele
macrocephalus
Moritzianus
nobilis
Palmeri
phaeacanthus
polylophus
Russelianus
salvadorensis
Sartorianus
senilis
CEREUS
aethiops
alacriportanus
azureus
Childsii
Dayami
Hankeanus
hexagonus
Hildmannianus
jamacaru
laetevirens?
pernambucensis monstrosus
peruvianus
peruvianus monstruosus
repandus
stenogonus
tetragonus
thalassinus
validus
CHAMAECEREUS
Silvestrii
CLEISTOCACTUS
areolatus
Baumannii
smaragdiflorus
Straussii?
COCHEMIEA
Poselgeri

CONSOLEA
catacantha
haitiensis
macracantha
Millspaughii
moniliformis
Nashii
rubescens

CORYPHANTHA
aggregata
Andreae
arizonica
clava
cornifera
cubensis
Hesteri
macromeris
neo-mexicana
Nickelsae
Palmeri
Runyonii
vivipara

DEAMIA
testudo

DENDROCEREUS
nudiflorus

DENMOZA
rhodacantha

DOLICHOTHELE
longimamma
sphaerica

ECHINOCACTUS
fossulatus?
Grusonii
horizonthalonius
ingens
polycephalus

ECHINOCEREUS
albispinus
angusticeps
arizonicus
Baileyi
Blanckii
Bonkerae
Boyce-Thompsoni
chlorophthalmus
cinerascens
coccineus
dasyacanthus
dubius
Engelmannii
enneacanthus
Fendleri
Fitchii
gonacanthus
Ledingi
longispinus
melanocentrus
mojavensis
octacanthus
oklahomensis
papillosus
pentalophus
polyacanthus
Poselgerianus
Reichenbachii
Rosei
sarissophorus
stramineus
triglochidiatus
Viereckii?
viridiflorus

ECHINOFOSSULOCACTUS
lamellosus

ECHINOMASTUS
erectocentrus
intertextus
Johnsonii

ECHINOPSIS
albiflora
albispinosa
calochlora
campylacantha
Colmarii?
Eyriesii
gemmata?
imperialis
Kratochviliana
Muelleri
multiplex
oxygona
paraguayensis
Quehlii
Ritteri
Schelhasei
Silvestrii
triumphans
tubiflora
turbinata
variabilis?
Wilkensii

ENCEPHALACARPUS
strobiliformis

EPIPHYLLUM
Hookeri
hybridum
oxypetalum
phyllanthus
stenopetalum
x "Sunset Gold"

EPITHELANTHA
micromeris
micromeris var. *Greggii*

ESCOBARIA
Sneedii
tuberculosa

FEROCACTUS
acanthodes
Covillei
crassihamatus
hamatocanthus
latispinus
Lecontei
melocactiformis
Rafaelensis?
rectispinus
Townsendianus
uncinatus
Wislizenii

FRAILEA
pumila

GRUSONIA
Bradtiana
Wrightiana

GYMNOCALYCIUM
lafaldense?
Mihanovichii
multiflorum
Netrelianum
saglione
Schickendantzii

HAMATOCACTUS
setispinus

HARRISIA
aboriginum
adscendens
Bonplandii
Brookii
Earlei
eriophora
Fernowii
fragrans
Jusbertii
Martinii
pomanensis
Simpsonii
tortuosa

HATIORA
salicornioides

HELIOCEREUS
speciosus

HOMALOCEPHALA
texensis

HYLOCEREUS
costaricensis
cubensis
ocamponis
polyrhizus
undatus

LEMAIREOCEREUS
Beneckei
chichipe
deficiens
Dumortieri
griseus
Hollianus
hystrix
pruinosus
queretoroensis
stellatus
Thurberi
Treleasei
Weberi

LEPISMIUM
cruciforme

LEPTOCEREUS
assurgens

LEUCHTENBERGIA
principis

LOBIVIA
cinnabarina
Graulichii
mistiensis
Pentlandii
pseudocachensis
saltensis

LOPHOCEREUS
Schottii

LOPHOPHORA
Williamsii

MACHAEROCEREUS
gummosus

MALACOCARPUS
Leninghausii
Ottonis
submammulosus
tabularis

MELOCACTUS
Harlowii
intortus
matanzanus

MONVILLEA
Anisitsii
Cavendishii
insularis
Lauterbachii
Spegazzinii

MYRTILLOCACTUS
cochal
geometrizans

NEOBESSEYA
missouriensis
similis

NEOLLOYDIA
texensis

NEOMAMMILLARIA
applanata
candida
capensis
Celsiana
cirrhifera?
compressa
elegans
elongata
elongata var. *stella-aurata*
fasciculata
Fraileana
fragilis?
Hahniana
hemisphaerica
Karwinskiana
kewensis
Macdougalii
magnimamma
meiacantha
microcarpa
mystax
Parkinsonii
Pettersonii
plumosa
Pottsii
pusilla?
Sempervivi
sphacelata
spinosissima
tenampensis
viridiflora
Wrightii
Zahniana

NOPALEA
Auberi
Brittoni
cochenillifera
dejecta
guatemalensis
Karwinskiana

NYCTOCEREUS
serpentinus

OBREGONIA
Denegrii

OPUNTIA
acanthocarpa
angustata
arbuscula
arenaria
basilaris
Bigelovii
brasiliensis
Cañada
chlorocarpa?
chlorotica
clavata
crassa
cylindrica
delicata?
Dillenii
discata
echinocarpa
Eichlamii
elata
Ellisiana
Engelmannii
fragilis
ficus-indica
fulgida
fulgida var. *mamillata*
glaucophylla?
Grahamii
Howeyi?
imbricata
inamoena
Kleiniae
Kunzei
laevis
lasiacantha
leptocaulis
leucotricha
linguiformis
Loomisii
macrocentra
maxima

microdasys
militaris
occidentalis
pachyarthra f. *flava?*
paraguayensis?
Parishii
phaeacantha
polyacantha
ramosissima
repens
retrorsa
rhodantha
robusta
rufida
Salmiana
santa-rita
spinosior
Stanlyi
stenochila?
stricta
subulata
tenuispina
tetracantha
Thornberi
tomentella
tomentosa
tortispina
trichophora
undulata
ursina
vivipara
vulgaris
vulgaris var. *variegata*
Whipplei
zacuapanensis

OREOCEREUS
Trollii

PACHYCEREUS
marginatus
pecten-aboriginum
Pringlei

PEDIOCACTUS
Simpsonii

PELECYPHORA
pectinata

PENIOCEREUS
Greggii

PERESKIA
aculeata
Bleo
Godseffiana
Nicoyana

PERESKIOPSIS
chapistle
pititache
velutina

RATHBUNIA
alamosensis

REBUTIA
Duursmaiana
Fiebrigii
minuscula
pseudo-deminuta
pygmaea
senilis var. *Stuemeriana*
Spegazziniana?
Steinmannii

RHIPSALIS
cassutha
cereuscula
crispata
dissimilis
gibberula
grandiflora
lumbricoides
paradoxa
pentaptera
rhombea
teres
Tonduzii
trigona

SELENICEREUS
Boeckmannii
grandiflorus?
Macdonaldiae
pteranthus
spinulosus
Urbanianus

SOLISIA
pectinata

STROMBOCACTUS
disciformis

THELOCACTUS
bicolor

TRICHOCEREUS
candicans
cuzcoensis
lamprochlorus
Pachanoi

peruvianus
Schickendantzii
Shaferi
Spachianus
strigosus
Terscheckii

WILCOXIA
Poselgeri
senilis
viperina

ZYGOCACTUS
truncatus

AIZOACEAE (FIG-MARIGOLD FAMILY)

In this very popular family is to be found an infinite variety of forms. Some species are very dwarf and practically stemless, others so closely resemble the stones among which they grow that it is almost impossible to tell them apart, and still others form carpet-like mats, several feet in diameter, composed of bright leaves and flowers of rainbow hues.

Recently, mesembryanthemums have become very popular with collectors of succulents. Many of the mimicry types, such as Lithops, Conophytum, Argyroderma, and Cheiridopsis, are so small that great numbers of them can be grown in a few pots set on the window-sill. "Mesembs" usually grow very easily from seed, but because many are native to the driest parts of Africa, watering must be attended to with care. Sunlight is a prime requisite, and without it plants cannot be expected to thrive, although partial shade (in the summer) is beneficial.

All the fig-marigolds were classed under one genus, Mesembryanthemum, up to about twenty years ago. Now it has been split up into over one hundred new genera. Revision is still going on, based largely upon fruit characteristics, and while the botanist is trying to bring order out of chaos, the gardener is confronted with learning all the new names that are being coined. The system here adopted is that of H. Jacobsen, in Fedde's "Repertorium" (1938).

ACRODON
bellidiflorus

AETHEPHYLLUM
pinnatifidum

AIZOON
canariense

ALOINOPSIS
Jamesii

APTENIA
cordifolia

ARGYRODERMA
testiculare

ARIDARIA
flexuosa
splendens
umbelliflora

ASTRIDIA
velutina

BERGERANTHUS
multiceps

scapiger
vespertinus

CARPANTHEA
pomeridiana

CEPHALOPHYLLUM
Alstonii

CHASMATOPHYLLUM
musculinum

CHEIRIDOPSIS
acuminata
aspera
carinata
carnea
Caroli-Schmidtii
cigarettifera
multiseriata
peculiaris
Pillansii
Vanzijlii

CONOPHYTUM
Luisae
Pillansii
Purpusii?
uvaeforme

CORPUSCULARIA
Lehmannii

DEILANTHE
Peersii

DELOSPERMA
Cooperi
Davyi
echinatum
Ecklonis
herbeum
hirtum
imbricatum
subincanum
Taylori

DOROTHEANTHUS
bellidiformis
gramineus

DROSANTHEMUM
floribundum
pauper

EREPSIA
Haworthii
heteropetala

FAUCARIA
Bosscheana
crassipetala
Duncanii
felina
felina var. *Jamesii*
hyneveldiae?
lupina
tigrina

GIBBAEUM
album
Heathii
Heathii var. *elevata*
Nebrownii
pubescens
velutinum

GLOTTIPHYLLUM
depressum
difforme
latum
linguiforme
longum
Nelii
proclive
taurinum
uncatum

HEREROA
granulata
incurva
Stanleyi?

HYMENOCYCLUS
purpureo-croceus

LAMPRANTHUS
aurantiacus
Brownii
elegans
emarginatus
falcatus
falciformis
lunatus
polyanthon
roseus
Stephanii

LAPIDARIA
Margaretae

LEIPOLDTIA
Britteniae

LITHOPS
Aucampiae
kuibisensis
kunjasensis
Lesliei
pseudotruncatella
terricolor

MACHAIROPHYLLUM
albidum

MESEMBRYANTHEMUM
album
fulgidum?
intrusum

NELIA
Meyeri

OSCULARIA
deltoides

PHYLLOBOLUS
resurgens

PLEIOSPILOS
Bolusii
Fergusoniae
magnipunctatus
nobilis
optatus
simulans

RABIEA
albinota

RHOMBOPHYLLUM
rhomboideum

RUSCHIA
acutangula
filamentosa
multiflora
perfoliata
rigida
vaginata

SCHÖNLANDIA
algoense?

SEMNANTHE
lacera

TITANOPSIS
calcarea
Schwantesii
setifera

TRICHODIADEMA
bulbosum
densum
setuliferum
stelligerum

MISCELLANEOUS SUCCULENTS

Of the plant families previously dealt with, the greatest number of the components are more or less succulent, but there are other families which contain a few fleshy members. The composite, or daisy family, includes several curious succulents, some of which have been in cultivation for a long time. Most of these belong to the genera *Kleinia, Notonia,* and *Othonna.* Kleinias are sun lovers, with odd flowers having unusually long peduncles, and glaucous leaves. *Othonna crassifolia* is suitable for hanging baskets, producing bright yellow flowers in abundance. It is often known as "little pickles," because of its tiny cucumber-like leaves.

The purslane family contains some gems for the rockery. Every one is acquainted with the brilliant flowers of *Portulaca grandiflora,* commonly referred to as "rose moss," and there are other equally fascinating species in this group. The South African *Portulacaria afra,* which is a bush or small tree in its native home, makes an excellent pot plant. It is the favorite food of the elephants and commonly is called "elephant plant." Talinums are chiefly tropical American herbs with succulent leaves, but a few members grow in the temperate regions of our country, and these are ideally suited for rock gardens.

The spiniform succulent *Pelargonium echinatum* is an example of desert geranium. This plant sheds its leaves during periods of drought, requires plenty of sun, and flowers profusely. The succulent grapes are represented by several species in the genus Cissus. The most curious is *Cissus quadrangularis,* a climbing, widely branching plant with quadrangular, green-winged stems constricted at the nodes, and alternate, deeply three-lobed leaves. The bromeliads, though not classed as succulents, are generally included in succulent collections, as they are a very interesting group of xerophytes. The mode of culture for Dyckias, Puyas, Hechtias, and similar genera is identical with that of cacti, and their rosette-forming habit appeals to the gardener.

PORTULACACEAE

Anacampseros
arachnoides
quinaria
rufescens
telephiastrum
tomentosa
tomentosa var. *crinita*
Portulaca pilosa
Portulacaria afra
Talinum
calycinum
paniculatum
parviflorum

VITACEAE

Cissus
Bainesii
incisa
quadrangularis

BROMELIACEAE

Dyckia
brevifolia
remotiflora
sulphurea
Puya chilensis

COMPOSITAE

Kleinia
acaulis
anteuphorbium
articulata
chordifolia
ficoides
neriifolia
repens
somaliensis
stapeliaeformis
tropaeolifolia
Notonia pendula
Othonna crassifolia

GERANIACEAE

Pelargonium echinatum

COMMELINACEAE

Tradescantia navicularis

NON-SUCCULENT DESERT PLANTS

This guide would be incomplete if some of the typical non-succulent desert plants were not included. Plants such as the mesquite and ocotillo are so characteristic in our southwestern deserts that they merit a place in all large conservatories.

On the slopes of the foothills, as well as in the plain, the ocotillo stretches its gaunt, wand-like, spiny stems. Mile after mile the lacy-leaved mesquite or the creosote bush with evergreen lacquered leaves is the dominant feature in the landscape. Along the desert washes the vegetation is even lush, with Lycium bushes, occasional acacias, desert hackberry, and palo verdes. In the early spring after the rains, the desert floor becomes splashed with a rich and varied display of flowers, but ironwood, desert broom, palo verde, catsclaw, mesquite, creosote and saltbush are more typical of the arid regions than these bright-colored herbs.

Several typical non-succulent desert plants are now thriving in the "Cactus House," many of which have been raised from seed collected on a trip to the Southwest in the fall of 1935. The retamas have grown luxuriantly and are now about ten feet high. The desert hackberry is now established, as are the ocotillos, saltbushes, and many others. The following have been planted in permanent beds.

Acacia Farnesiana (Huisache)
Acacia Greggii (Catsclaw)
Atriplex canescens (Saltbush)
Bumelia occidentalis
Callistemon phoeniceus
Cassia Wislizenii
Ephedra equisetina
Fouquieria splendens (Ocotillo)
Idria columnaria (Living telegraph pole)
Jatropha Curcas
Jatropha podagrica (French physic nut)
Jatropha sp. (?)
Leucodendron argenteum (Silver tree)
Lycium brevipes (Desert matrimony bush)
Lycium pallidum
Parkinsonia aculeata (Retama)
Parkinsonia microphylla (Palo verde)
Prosopis juliflora (Mesquite)
Zizyphus lycioides

L. C.

STATISTICAL INFORMATION FOR APRIL AND MAY, 1938

GARDEN ATTENDANCE:

Total number of visitors in April	32,822
Total number of visitors in May	42,046

PLANT ACCESSIONS:

Total number of plants and packets of seeds donated in April	175
Total number of plants and packets of seeds donated in May	130

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought in April	25
Total number of books and pamphlets donated in April	187
Total number of books bought in May	15
Total number of books and pamphlets donated in May	61

HERBARIUM ACCESSIONS:

APRIL

By Purchase—	
Magnusson, A. H.—Plants of Sweden, etc.	150
Nelson, A. W.—Plants of Arizona	410
By Gift—	
Dodge, C. W.—Plants of Costa Rica and Panama	7
Evans, A. W.—Plants of Jamaica	12
Hillmann, J.—Plants of Germany and France	10
Pring, George H.—Plants of horticulture	5
By Exchange—	
Botanical Institute, University of Brünn—"Exsiccatae, Republicae Bohemicae Slovenicae," Cent. XII and XIII, Nos. 1101-1300 inclusive	200
U. S. National Museum, Washington, D. C.—Plants of Virginia	122
Total	916

MAY

By Purchase—	
Hinton, Geo. B.—Plants of Mexico	507
Kenoyer, L. A.—Plants of Mexico	581
Steyermark, Julian A.—Plants of Missouri	4,000
University of California Botanical Garden by T. H. Goodspeed —Plants of South America	129
By Gift—	
Anderson, Edgar—Plants of Missouri	5
Benke, H. C.—Plants of Wisconsin and Louisiana	3
Chandler, Albert—Plants of Texas	4
Cutler, Hugh C.—Plants of Texas and Utah	3

Hubricht, Leslie—Plants of Illinois and Missouri	13
Museum of Natural History, Botanical Division, Vienna, by K. Keissler—Fragments and photograph of *Apocynum sibiricum* Jacq.	1
Steyermark, Julian A.—Plants of Missouri	400
By Exchange—	
Ewan, Joseph—Plants of the San Gabriel Mts., California	61
Florida Agricultural Experiment Station by Erdman West —Plants of Florida	52
Fort Hays Kansas State College by F. W. Albertson—Plants of Kansas	102
Grant, Adele Lewis—Plants of South Africa	485
Gray Herbarium, Harvard University—Plants of Virginia	92
Marshall College, Department of Botany, by F. A. Gilbert —Plants of West Virginia	100
Philadelphia Academy of Natural Sciences Herbarium—Plants of New Jersey and other eastern states, collected by Kenneth K. Mackenzie	300
Purer, Edith A.—*Marsilia vestita* Hook. & Grev. from California	1
By Transfer—	
Anderson, Edgar—Plants of horticulture	3
Total	6,842

FLOWER OF PLEIOSPILOS SIMULANS JUST BEFORE CLOSING

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GERALD E. ULRICI

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and while virtually a private garden it was, except at certain stated times, always open to the public. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was designated by Mr. Shaw as its official title and in his will or in any of his writings he specifically referred to it as the "Missouri Botanical Garden." By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will, the immediate direction of the Garden is vested in a Director, appointed by the Board of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises 75 acres, where about 12,000 species of plants are growing. There is now in process of development a tract of land of over 1,600 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees, and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a wild-flower reservation, with the idea that possibly at some future time this may become the new botanical garden.

The Garden is open to the public every day in the year, except New Year's Day and Christmas—week days from 8:00 a. m. until sunset; Sundays from 10:00 a. m. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Place, on the Sarah car line (No. 42). Transfer south from all intersecting lines.

PRESSURE FEEDING GUN.

1. PRESSURE FEEDING GUN IN POSITION TO DRILL HOLE. 2. HALF-WAY. DEPTH OF FEEDING CAN BE CONTROLLED. 3. HOLE DRILLED. READY TO CHARGE CYLINDER WITH FERTILIZER. 4. SECOND CHARGE OF 1½ POUNDS BEING POURED INTO GUN.

Missouri Botanical Garden Bulletin

Vol. XXVI SEPTEMBER, 1938 No. 7

THE GENERAL CARE OF SHADE TREES

This number of the BULLETIN has been prepared for the Fourteenth National Shade Tree Conference which met in St. Louis August 30-September 2, 1938. While previous issues of the BULLETIN have discussed various specific phases of tree care, this number is intended to serve as a more or less comprehensive survey of the entire field. It summarizes the methods now in use and may assist the private owner in planning a program for the preservation of his trees.

The Pruning of Shade Trees.—Shade trees, as distinguished from horticultural forms grown for flowers or fruit, should be pruned for several legitimate reasons: First, dead wood should be removed to reduce the possibility of fungous infection. Second, competing or interferring branches should be removed to preserve the symmetry of the tree. Third, "anticipatory" pruning should be practiced. Of the three reasons only the last needs much amplification. Most tree workers come to recognize certain branches whose weakness and position indicate that they are declining and will shortly lose out in the struggle for light and food. The death of such branches is a slow process. Several seasons may elapse before they are so reduced in vigor that they no longer produce leaves. To detect such branches beforehand requires more experience and keener observation but it yields greater returns, since the pruning cuts are made in living tissue and healing is more rapid than with dead branches.

Perhaps mention should be made of the customary "topping" or "trimming" frequently practiced in this region. This method of

pruning can hardly be termed legitimate. When carried on for several seasons the injury following from decay is as great as that from sleet or wind, which the topping is supposed to prevent. The effect on the tree will be the same, regardless of how the branches are removed.

Shade trees may be pruned at any season, although scars made in March and April heal much faster than those made later in the summer. The wood of the trunk and larger limbs which has been exposed during pruning needs some protection against the entrance of disease and insects. For this purpose many forms of patented tree paints are available. Of the many materials that have been used, asphalt and asbestos, pine tar, and rubber may be mentioned. Although the perfect tree paint has not been produced, most patented kinds are designed to fill the following requirements: first, toxic to fungous spores; second, ample elasticity to bridge weather checks in the wood; third, ability to withstand weathering; fourth, non-injurious to growing tissue.

Lightning Protection for Trees.—Within the past few years special attention has been paid to preventing damage to trees by lightning. The injury caused by lightning varies a great deal. The accompanying illustrations (pl. 14) show that it may burn and kill just a narrow strip of bark or it may cause the tree to explode, wholly destroying a valuable specimen. Generally the larger and more conspicuous trees are struck. Special types of connectors and and conductors, as well as points and methods of attaching the conductors to the tree, have been developed. The protection afforded by these lightning rods seems to justify the expense, although the installation should be left to a capable tree worker. Several large sycamores west of the iris test garden which were struck repeatedly during several summers, have been protected with lightning rods. Since then there has been no additional injury; at least there is nothing to indicate that they have been struck during the past several summers.

The Cabling and Bracing of Trees.—Some trees, notably the pin oak, grow with a single trunk. Others, such as the elm, have multiple trunks arising from a sharp fork. These are structurally unsound and often break under the weight of sleet or pressure of

PIN OAK BEFORE AND AFTER PRUNING

1
Explosive effect on sugar maple

2
Surface injury to sycamore

EFFECT OF LIGHTNING ON TREES

wind. It will be seen from the accompanying figure that such sharp forks are not closely united. They result when two parallel branches grow with equal vigor. Later, when they increase in size, the two inside surfaces meet (pl. 15, fig. 1), forming a collar of bark. The two limbs are then pushed farther apart with

Fig. 1. Two sharp crotches, typical of elm, which careful pruning would have corrected.

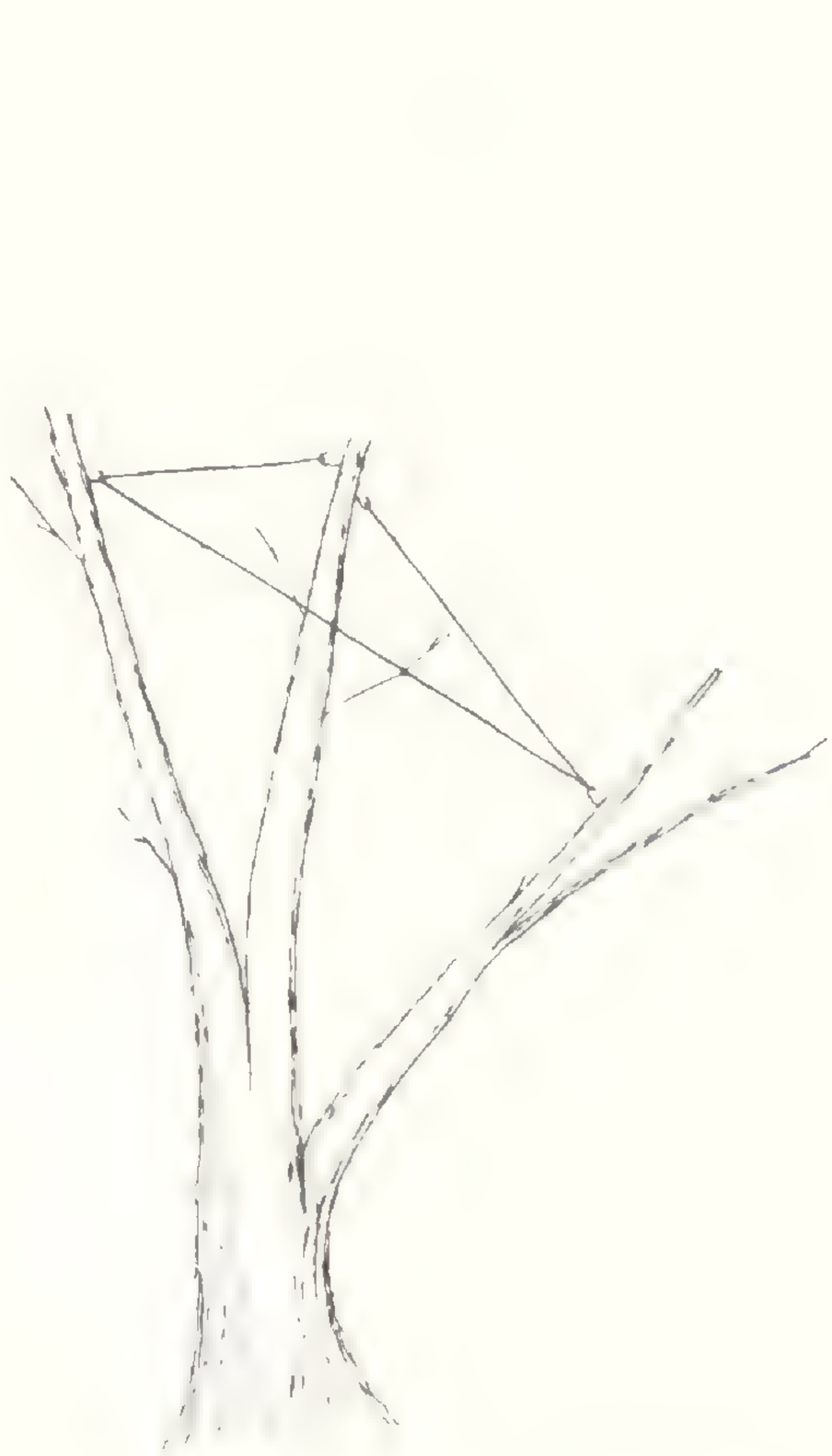


Fig. 2. Type of bracing necessary in multi-leader tree developing sharp crotches.

each season's growth. At some future time the pressure of the expanding tissue will be great enough to kill the bark in the center. The condition becomes more and more aggravated with each season's growth until finally a pocket is formed in the center. Since the bark is dead, that portion of the tree is unprotected, furnishing ideal lodging for the spores of decay fungi. Summer rains keep this pocket filled with water which freezes during the winter.

The freezing further helps to push the two limbs from a vertical position, causing the fork to split. Wind often twists the two limbs in opposite directions, and the grinding motion which then occurs kills more of the bark at the edges of the split. After many years, if storms have not demolished the tree, the fork will appear as in pl. 15, fig. 2. Should the tree be cut down and examined it would be found to have the structure of two individual trees with the split continuing much farther downward in the interior than is shown by the outside bark. Only the growth of a single summer will be continuous around the tree, and this will be broken the following winter. Above this the union of the two trunks becomes even less solid until they finally separate. In order to prevent damage of this sort it has become the practice to support such branches with cables. Special materials have been developed for cabling trees.

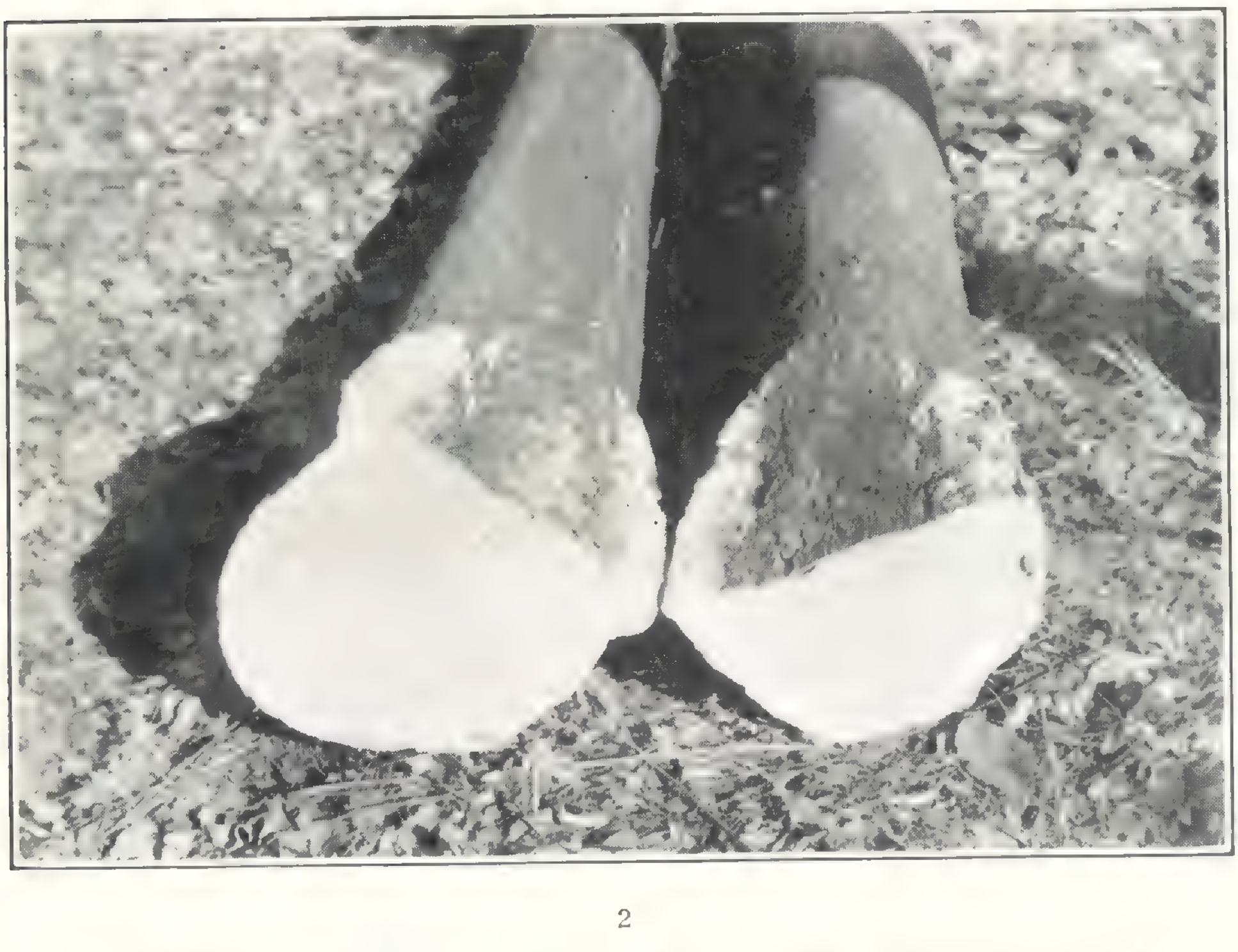
Years ago iron bands were frequently placed around a tree to prevent it splitting. These bands effectively shut off the flow of sap and often caused as much harm as might wind. Some of these "banding" devices were equipped with turnbuckles and other ingenious accessories permitting them to be loosened as the tree grew in diameter. These methods all had the same fault; they required some adjustment at least once a year to prevent the girdling of the branch which they were installed to protect. Heavy chain was also used, but to-day screw hooks and flexible cable are the cabling materials. On occasion threaded rod is needed to hold split forks together, and the combination of cables near the tree top and rods through the fork will entirely eliminate future damage. However, the installation of such bracing is best left to a competent tree surgeon, since it involves much climbing and special tools and considerable experience.

The Feeding of Shade Trees.—The manner in which trees may be fed and the materials which have been used as food have been the subject of previous BULLETINS. This controversial subject is again introduced here simply to clarify certain points in the work previously reported and to answer certain criticisms.

The need to supply additional food to shade trees is generally recognized by the professional tree worker, but the tree owner

1

TRANSVERSE SECTION TWO FEET BELOW TOP OF FORK, SHOWING DEAD BARK SEAM IN INTERIOR



2

UPPERMOST SECTION OF AILANTHUS TREE. WHITE RING AT OUTSIDE SHOWS POINT OF ATTACHMENT, THIS BEING TOP OF POCKET

has not always been ready to accept starvation as the underlying cause of many tree troubles. A detailed diagnosis of starvation is beyond the scope of this BULLETIN. However, with some practice, the vigor of a tree can be determined from the growth rate of the terminal shoot, from the size and color of the foliage, and the extent of the bark fissures. Branches of an average shade tree should produce a yearly growth of eight inches.

It is generally conceded that only three elements are needed in shade-tree feeding. These three are: nitrogen, phosphorus, and potash. Under certain conditions a lack of lime, iron, or some of the "rarer" elements may limit tree growth. Generally a fertilizer containing the first three elements will prove effective. As a result of the experimental work carried on at the Garden these elements have been combined in a fertilizer having a formula containing 10 per cent nitrogen, 8 per cent phosphorus, and 6 per cent potash. This formula has been used because it is the practical limit in concentration which might be obtained from ammonium sulphate, superphosphate, and muriate of potash. It is the only formula of many possible combinations used during a period of seven years which gave consistent and predictable results. The formula is by no means wholly satisfactory, yet more highly concentrated fertilizers are effective only when applied with water or air pressure to force diffusion through the soil. The necessary nitrogen, phosphorus, and potash can be obtained from other materials than those mentioned, and their substitution may be justified in fertilizers for specific conditions. Essentially a shade-tree fertilizer must be quickly available and should contain a relatively large amount of nitrogen, since this one element is very often the first to become deficient and limit tree growth. The practice of combining organic and inorganic fertilizers is not supported by experimental evidence. One application of 10-8-6 combination has been proved effective for four succeeding years.

Early spring is the time to apply fertilizer in order to stimulate growth. Based on several years of dendrographic records, an application later than June 10 is not likely to have effect during that same year. Fertilizers control the rate of growth as well as the amount of growth, but have little influence on the periodicity of growth. Late summer is a period of food storage for most

trees, at which time there is little active increase in twig length or trunk diameter. Fertilizers used then seem less effective, since they are stored in some form, along with water, against the coming season. However, food may be given during any part of the year, with the assurance that it will be used at a later date, if the peak of the growth period has passed. An early spring application should produce an immediate improvement in the condition of the tree.

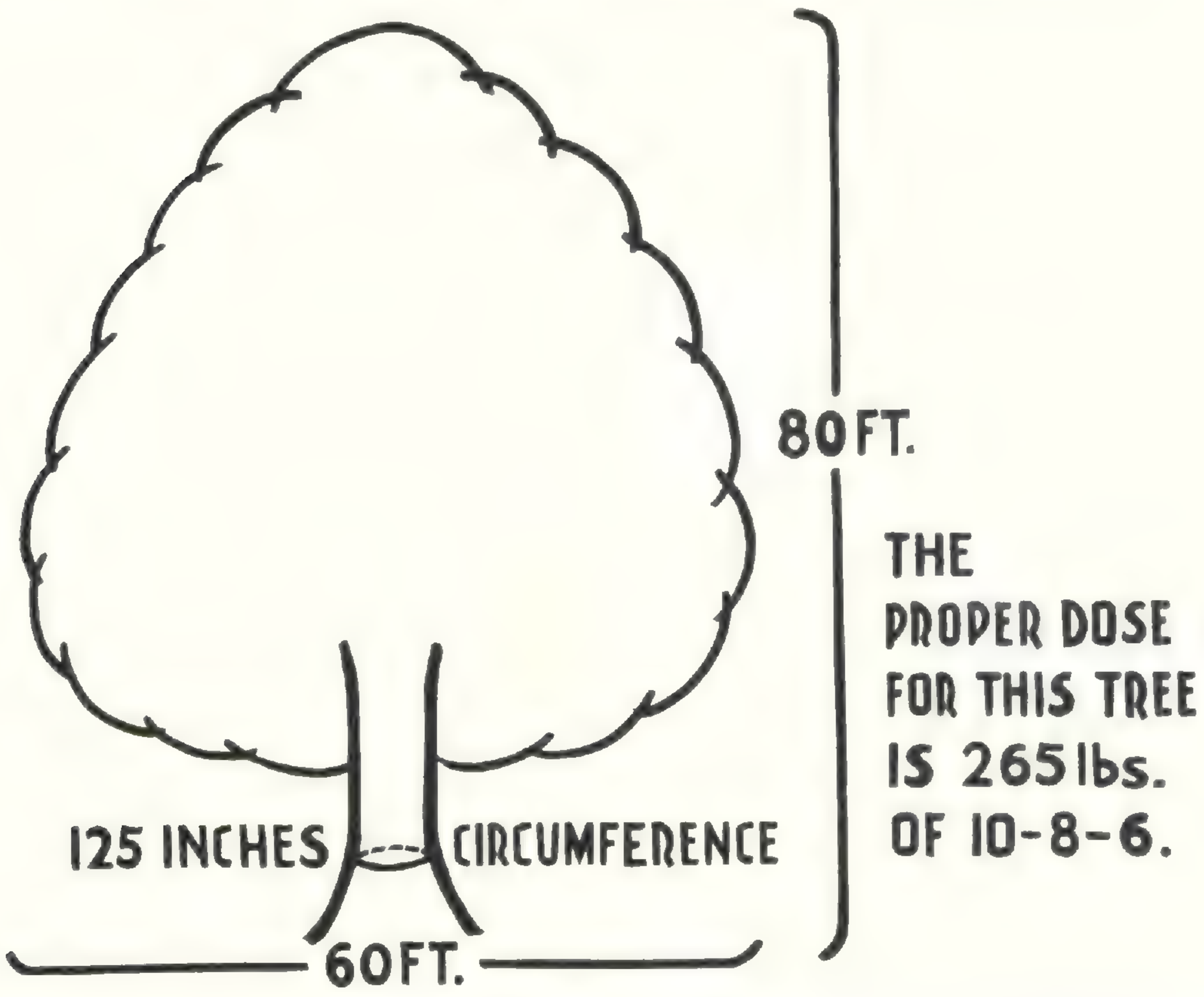


Fig. 3. How fertilizer dosage is calculated: To the height in feet (80), add the branch spread in feet (60) and the trunk circumference in inches (125). The sum is the amount of 10-8-6 fertilizer needed.

In earlier publications dealing with tree feeding, it was stated that "shade trees cannot be over-fed," and subsequent experience has emphasized this fact. Deuber (Proc. Thirteenth Natl. Shade Tree Conf.) relates an experiment in which shade trees were injured by over-feeding. He fed 10-8-6 fertilizer and Bartlett Green Tree Food (a proprietary formula) and found that the

"high-analysis 10-8-6" was uniformly injurious. It is difficult to determine from his summary if the rate of application or the formula were at fault. The rate of application, or the dosage based on many measurements, has been previously published (April, 1933, BULLETIN) as being the "sum of the height, branch spread, and circumference." (Fig. 3.) It is conceded that this is an empirical formula, designed to suit the needs of the tree owner and the yard-man, and to serve as a guide for the professional tree worker. It is unfortunate that a trained investigator should apply

Dense forest type. Use ½ of calculated dose.

Open forest, street, or lawn type. Use ⅔ of calculated dose.

Specimen type. Use full amount.

Fig. 4

this rule to a row of nursery trees, since here each tree has access to the fertilizer intended for its neighbor. It is equally unfortunate that the emphasis placed on the pressure feeding-gun and the highly desirable "forced diffusion" following its use should have been overlooked. The crow-bar method, now antiquated, permits maximum concentration of fertilizer in impervious pockets punched in the vicinity of the roots.

Cavity Filling.—The removal of decay and the filling of the cavity have long been one of the spectacular tree-preservation operations. Not all of this work has been justified, and cavity

work, although much improved to-day, is not a cure-all for tree troubles.

Fig. 5. Decay back of pruning cut.

It is very nearly, if not, impossible, to remove all traces of decay from large trunks. Frequently the mycelium of the fungus penetrates far beyond the discolored areas which limit the extent of most excavations. In too many cases only the most careful laboratory examination will disclose the extent of the decay, and such a

procedure is entirely impossible in field work. There are many wood-rotting fungi, some of which are difficult to identify in the field, especially in the absence of the mushroom-like fruiting bodies.

Most species of wood-rotting fungi enter the tree through a break in the corky armor (fig. 5), the bark. Some forms can grow and continue their destruction of sound wood only in the presence of ample oxygen. This type may be controlled by the usual procedure of excavating all discolored wood and filling the cavity with some permanent material. There are other species, however, which may continue to grow although they are cut off from the atmosphere by a filling. Some of the "white heart" rots, for instance, destroy sound wood so rapidly that there is no external evidence of injury until the typical "mushroom" appears at some opening in the bark. At this time an examination discloses that only a shell of sound wood remains. However, most fungi grow rather slowly; in fact, many are able just to keep pace with the annual growth. A vigorous tree attacked by this type may grow to great size provided a storm does not end its career.

This does not mean that all cavity work is without value. Many trees are well worth the effort and expense required to excavate and fill the decayed areas. The difficulty lies in arriving at some basis for evaluating the proposed work. For instance, it will be undesirable to attempt extensive cavity work on any of the "weed" trees—ailanthus, box-elder, or poplar. It is certainly true that, in and about St. Louis, cavity work may prove a very bad investment if the tree is infested or likely to be infested with termites. At the present time there is no practical control for termites in trees. Both the ash and the locust might be added to the list of trees not likely to benefit from cavity work, since they are seriously and repeatedly injured by borers.

It would seem then that cavity work is justified when practiced on some long-lived tree not subject to regular attacks by destructive insects. However, the patient must be growing vigorously, or at least not declining due to a deficiency of food or water. The food requirements can be generally met by applying fertilizers, while the water needs may be supplemented by irrigation. It is

important, however, that the water table remain unchanged. This may involve careful planning when contemplating some new grading or construction.

The decayed portions of a tree may be removed and the cavity

Fig. 6. Rotted interior of largest sycamore tree in lowland tract, Mississippi County.

excavated by hand with the aid of a chisel and mallet, or some of the newer power tools can be used for this work. The shape of the cavity must closely follow the flow of sap as found in that particular tree. It must be "streamlined," beginning with a sharp point at the top, widening toward the center and ending in a sharp

point at the bottom. While this work is being carried on the bark must not be bruised and the edge must be kept covered with shellac to prevent drying. If the excavation is quite large and deep it may be necessary to install threaded rod to prevent splitting. The exposed heartwood should be painted with some satisfactory pruning paint.

There are a number of methods and several kinds of material commonly used in filling cavities. The method used and the material itself are often patented. However, concrete made of two parts sand and one part cement is entirely satisfactory. The chief purpose of a filling is to furnish a surface over which the new bark may grow. Cavities may be left open and not filled, although they may detract from the symmetry of the trunk.

Actually no filling is wholly effective in preventing reinfection. Microscopic openings appear alongside the filling and even beneath the callus and the surface of the filling. These openings appear daily during the growing season and may remain for several days during cold weather in winter. A normal tree shrinks in diameter during the day, and at the same time the filling expands because of higher temperatures. At night the filling contracts along with lower temperatures while the tree expands. Thus a perceptible opening may occur between the filling and the tree several times each day. In winter, however, the opening is much larger and may remain open for the duration of the sub-zero weather. This behavior is probably the reason why portions of fillings are ejected.

The Control of Insects.—Insect control remains one of the very important phases of shade-tree preservation. It is not possible to cover this question within the pages of this BULLETIN. However, no extensive program of tree care should be attempted without giving serious consideration to the problem of controlling whatever destructive insects may be present. It will do no good to prune, cable, and feed a tree if it is being injured by some insect pest. It is even more important that cavity work be withheld until all destructive pests are partially controlled.

Generally, shade trees are too large for spraying with ordinary hand-operated equipment. The most effective spray or dust will

be nearly worthless unless it reaches the foliage as a fine mist, and this requires special equipment operating at high pressures.

The care of shade trees may be summarized as follows:

Shade trees must be pruned to remove dead and dying branches; to guard against the formation of weak forks, and to lessen the possibility of wind and sleet damage.

Unusual specimens, those growing in conspicuous locations, and very large and valuable trees should be protected from lightning.

Very many trees, because of branching habit, require cabling and bracing.

The preservation of any large shade tree often becomes a problem of supplying ample food in the form of commercial fertilizer.

Certain trees, because of their value, may require excavating and filling of diseased areas.

All shade trees should be protected against insect attacks.

Some of the more important BULLETINS dealing with shade trees which have previously appeared are listed below:

Flowering Plants for St. Louis. Trees. Mo. Bot. Gard. Bull. Vol. 3, No. 9. Sept., 1915.

The Feeding of Shade and Ornamental Trees. Mo. Bot. Gard. Bull. Vol. 17, No. 10. Oct., 1929.

The Pruning of Ornamental Trees and Shrubs. Mo. Bot. Gard. Bull. Vol. 18, No. 3. March, 1930.

Weak Branching in Trees. Mo. Bot. Gard. Bull. Vol. 20, No. 6. June, 1932.

The Most Interesting Tree in Missouri *(Taxodium distichum)*. Mo. Bot. Gard. Bull. Vol. 20, No. 10. Dec., 1932.

When Is the Best Time to Prune a Tree? (Maples). Mo. Bot. Gard. Bull. Vol. 21, No. 4. April, 1933.

Feeding the Shade Trees. Mo. Bot. Gard. Bull. Vol. 21, No. 4. April, 1933.

Moisture and Temperature Relations in Trees. Mo. Bot. Gard. Bull. Vol. 23, No. 3. March, 1935.

Some Migratory Trees. Mo. Bot. Gard. Bull. Vol. 24, No. 5. May, 1936.

Winter Injury to Trees and Shrubs. Mo. Bot. Gard. Bull. Vol. 24, No. 5. May, 1936.

Most of these may be obtained upon receipt of price, fifteen cents.

A. P. B.

NOTES

Dr. Edgar Anderson, Geneticist to the Garden, spoke to the St. Louis Garden Club, May 19, on "Understanding Wild Flowers."

As has been the custom for several years, a wreath of orchids and magnolias was placed on Henry Shaw's tomb, August 25, the anniversary of his death.

The botany classes of the University of Missouri, accompanied by Dr. W. B. Drew and Dr. Ilda McVeigh, instructors in botany, visited the Garden, May 14.

Dr. George T. Moore, Director of the Garden, spoke before the St. Louis section of the American Chemical Society, at the De Soto Hotel, May 2, on "Plants and People."

The *Bulletin of the Chrysanthemum Society of America* (Vol. 6, No. 2) contains an article on "Cascade Chrysanthemums," by Mr. Paul A. Kohl, Floriculturist to the Garden.

"Sansevierias as House Plants," an article from the June, 1937, BULLETIN, by Mr. Ladislaus Cutak, in Charge of Succulents at the Garden, was reprinted in the April issue of *Desert Plant Life*.

The annual flower sermon, for which Henry Shaw provided in his will, was preached at Christ Church Cathedral, May 1, by the Rev. Reinhold Niebuhr, of Union Theological Seminary, New York City.

The recent number of *The North American Flora* (Vol. 29, pt. 2), publication of the New York Botanical Garden, consists of the treatment of the family "Apocynaceae," by Dr. R. E. Woodson, Jr., Assistant Curator of the Herbarium.

Mr. Ladislaus Cutak, in Charge of Succulents at the Garden, gave an illustrated lecture before the Young People's Club of Our Lady of Lourdes Church, University City, Mo., June 1, on "Vagabonding in the Southwest."

Dr. Robert E. Woodson, Jr., Assistant Professor of Botany, and Mr. Russell J. Seibert, Graduate Assistant in Botany, spent the summer in Panama and Costa Rica, collecting plants preparatory to the issuance of a "Flora of Panama."

Mr. George H. Pring, Superintendent of the Garden, has returned from England and Scotland, where he visited the Royal Botanic Gardens at Kew and at Edinburgh, the Glasgow Botanic Garden, and the Royal Horticultural Society test gardens at Wisley.

Mr. Ladislaus Cutak, in Charge of Succulents at the Garden, spent a fortnight during July in Arkansas, Oklahoma and Texas. Over 3600 miles were travelled, and such interesting regions as the Big Bend country, Lower Rio Grande Valley, Padre Island, and Arbuckle Mountains were visited in search of herbarium specimens and living plants for the Garden and in photographing plant life in its natural habitats.

Mr. Paul A. Kohl, Floriculturist to the Garden, has given the following talks recently: "A Year in the Garden" before the Business and Professional Women's Group of the Church of St. Michael and St. George, April 25; "Gardening" before the Junior Gardeners of the St. Louis Garden Club, April 29; "Roses" before the Winstanley Garden Club of East St. Louis, May 19.

Dr. Edgar Anderson, Geneticist to the Garden, and Dr. W. B. Turrill, of Kew, England, are the authors of a paper in the *New Phytologist* (**37:** 160–172), entitled "Statistical Studies on Two Populations of Fraxinus"; Dr. Anderson and Mr. Leslie Hubricht have a paper in the *American Journal of Botany* (**25:** 396. 402), "Hybridization in Tradescantia. III. The Evidence for Introgressive Hybridization."

Mr. George H. Pring, Superintendent of the Garden, has given the following talks: "The Missouri Botanical Garden, Past and Present," before the elementary botany class of Washington University, April 27; "Commercial Flower Growing in England," before the St. Louis Florists Club, July 14; "English Gardens," before the St. Louis Horticultural Society, August 5; and "Originating New Flowers at the Garden," before the South Side Kiwanis Club, August 12.

The April number of the *Annals of the Missouri Botanical Garden* (Vol. XXV, No. 2), has been issued, with the following con-

tents: "Optical and Chemical Studies on the Granules in Microspores of Tradescantia," Francis O. Schmitt and G. T. Johnson; "Botany of the Second Byrd Antarctic Expedition. I. Ecology and Geographical Distribution," Paul A. Siple; "II. Lichens and Lichen Parasites," Carroll W. Dodge and Gladys E. Baker; and "III. Mosses," Edwin B. Bartram.

Visitors to the Garden during the summer months include: Dr. Oakes Ames, professor of botany, Harvard University; Dr. Esther Adams, teacher of biological sciences, Moberly Junior College, Moberly, Mo.; Mr. E. G. Beinhart, A.A.A., U. S. Dept. of Agr., Washington, D. C.; Mr. Karl Busch, in charge of greenhouses, Iowa State College, Ames; Miss Grace Denny, teacher of biology, East Texas State College, Commerce, Texas; Mr. A. F. Dodge, of the Soil Conservation Service, U. S. Dept. Agr., Ames, Iowa, Dr. W. B. Drew, assistant professor of botany, University of Missouri, Columbia; Mr. E. T. Edwards, plant pathologist, Dept. of Agr., New South Wales, Australia; Dr. Harry J. Fuller, assistant professor of botany, University of Illinois; Dr. George J. Goodman, assistant professor of botany, Iowa State College, Ames; Miss Lena B. Henderson, associate professor of botany, Randolph Macon College, Lynchburg, Va.; Mr. Ben Lowenhaupt, student, Iowa State College, Ames; Dr. John Adam Moore, instructor in botany, Huron College, Huron, S. D.; Mr. J. T. Middleton, graduate assistant in botany, University of Missouri, Columbia; Dr. E. E. Naylor, assistant professor of botany, University of Missouri Columbia; Mr. Clark Paris, graduate student, Iowa State College, Ames; Mr. Richard E. Schultes, of the department of economic botany, Harvard University, Cambridge, Mass.; Dr. Hiram M. Showalter, professor of biology, King's College, Bristol, Tenn.; Dr. Jennie L. S. Simpson, assistant professor of biological sciences, Hunter College, New York; Dr. J. A. Steyermark, assistant curator of the herbarium, Field Museum of Natural History, Chicago; Mr. C. Ken Weidner, assistant superintendent, department of buildings and grounds, University of Washington, Seattle; Dr. Louis Williams, research assistant, Botanical Museum of Harvard University, Cambridge, Mass.; Dr. F. L. Wynd, assistant professor of Botany, University of Illinois, Urbana.

STATISTICAL INFORMATION FOR JUNE AND JULY, 1938

GARDEN ATTENDANCE:

Total number of visitors in June	35,667
Total number of visitors in July	6,552

PLANT ACCESSIONS:

Total number of plants and packets of seeds donated in July	100

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought in June	69
Total number of books and pamphlets donated in June	86
Total number of books bought in July	14
Total number of books and pamphlets donated in July	366

HERBARIUM ACCESSIONS:

JUNE

By Purchase—

Erker Bros. Optical Co.—Photographs of types	3

By Gift—

Azael, Hermano—Plants of Colombia	17
Bechtold, Mrs. William—*Clivia miniata* Regel from horticulture	1
Deam, Charles C.—*Crotalaria spectabilis* Roth from Florida	1
Featherly, H. I.—*Triodia oklahomensis* Feath. from Oklahoma	1
Greenman, J. M.—Photographs of type specimens of *Senecio* from South America	30
Harrison, Charles H.—Fungi of Washington	8
Kellogg, John H.—*Nemopanthus mucronata* (L.) Trel. from Missouri	2
Lodewyks, Maude C.—*Ligustrum* sp. from horticulture	1
von Schrenk, Hermann—Plants of Missouri	12
Stevens, N. E.—Plants of the Philippine Islands, etc.	136

By Exchange—

Gray Herbarium, Harvard University—Plantae Grayanae, Cent. VIII, Nos. 701-800 inclusive	100
Gray Herbarium, Harvard University—Plants of Cuba, etc.	47
University of Colorado by F. Ramaley—Plants of Colorado	72
University of Pennsylvania by John M. Fogg, Jr.—Plants of southern New Jersey	50

By Field Work—

Hubricht, Leslie—Lichens of western United States	570

By Transfer—

Fairburn, David C.—Plants of horticulture	3
Total	1054

JULY

By Purchase—

Eyerdam, Walter J.—Plants of Washington	196
Skutch, Alexander F.—Plants of Costa Rica	336

By Gift—

Anderson, Edgar—Plants of Ontario, Canada	6
Happ, George B.—Plants of Mexico	285
Hubricht, Leslie—Plants of central United States	117
Kellogg, John H.—*Hypochaeris radicata* L. from Missouri	1
Larkins, G. O.—*Monarda didyma* L. from horticulture	1
Layton, Mrs. Emmet—*Martynia louisiana* Mill. from Missouri	1
McVaugh, Rogers—Plants of Georgia	32
Martinez, Jr., Eduardo—Plants of Colombia	7
Schwarz, Hermann—Plants of Colorado and New Mexico	143

By Exchange—

Arnold Arboretum, Harvard University—Miscellaneous duplicate specimens	775
Botanical Garden, Bacou, URSS.—Plants from Transcaucasia	206
Botanical Museum, Harvard University—*Phragmorchis teretifolia* L. Wms. from the Philippine Islands	1
Fort Hayes Kansas State College—Plants of Kansas	100
University of California---Plants of California	290

By Transfer—

Fairburn, David C. and Ben Löwenhaupt—Plants of horticulture	94
Total	2591

STAFF
OF THE MISSOURI BOTANICAL GARDEN

THE GARDEN, 2315 TOWER GROVE AVENUE, ST. LOUIS, MISSOURI

GEORGE T. MOORE,
Director

HERMANN VON SCHRENK,
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CARROLL W. DODGE,
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JESSE M. GREENMAN,
Curator of Herbarium

EDGAR ANDERSON,
Geneticist

ERNEST S. REYNOLDS,
Physiologist

ROBERT E. WOODSON, JR.,
Assistant Curator of Herbarium

NELL C. HORNER,
Librarian and Editor of Publications

GEORGE H. PRING,
Superintendent

JOHN NOYES,
Consulting Landscape Architect

PAUL A. KOHL,
Floriculturist

WILLIAM F. LANGAN,
Chief Engineer

AUGUST P. BEILMANN,
Arboriculturist

JOSEPH LANGEN,
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Plant Recorder

JOHN H. KELLOGG,
Plant Collector

ALBERT PEARSON,
Painter

JOSEPH CUTAK,
In charge of Exotics

LADISLAUS CUTAK,
In charge of Succulents

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Manager

REPRESENTATIVE IN EUROPE

GURNEY WILSON, F. L. S.,
Hove, Sussex, England

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. XXVI OCTOBER, 1938 No. 8

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and while virtually a private garden it was, except at certain stated times, always open to the public. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was designated by Mr. Shaw as its official title and in his will and all of his writings he specifically referred to it as the "Missouri Botanical Garden." By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will, the immediate direction of the Garden is vested in a Director, appointed by the Board of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises 75 acres, where about 12,000 species of plants are growing. There is now in process of development a tract of land of over 1,600 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees, and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a wild-flower reservation, with the idea that possibly at some future time this may become the new botanical garden.

The Garden is open to the public every day in the year, except New Year's Day and Christmas—week days from 8:00 a. m. until sunset; Sundays from 10:00 a. m. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Place, on the Sarah car line (No. 42). Transfer south from all intersecting lines.

LARGE HANGING-BASKET CHRYSANTHEMUM

Missouri Botanical Garden Bulletin

Vol. XXVI OCTOBER, 1938 No. 8

WHAT IS INVOLVED IN SETTING UP THE CHRYSANTHEMUM SHOW

St. Louisans have been fortunate in having had the privilege, each November, for many years, of viewing a chrysanthemum show. From an humble beginning, in 1891, when the show was held in the old Exposition Building, located on the present site of the Central Library, the display has gradually grown in magnitude until now, with modern transportation, it attracts not only local visitors but many from distant places. As early as 1893 chrysanthemums were displayed at the Garden in a small greenhouse erected in that year. At the St. Louis World's Fair, in 1904, the Missouri Botanical Garden exhibited a collection of chrysanthemums for competition and received the first prize. From 1905 until 1910 the plants were shown in a tent in the Garden parterre. The United Railways Co. had installed lights, and on some evenings the display was open until 10:00 p. m. In 1911 the chrysanthemums were again placed under canvas, but before the show was opened a severe storm completely destroyed the tent and plants. In 1912 the chrysanthemums were displayed in half of the north wing of the new conservatory, although the building was still under construction. The following year the entire north wing was used, and in 1914 the south wing contained the show. Since November, 1915, when the new floral display house was first opened, the chrysanthemum shows have been held there.

To the public the closing of the chrysanthemum show in late November is the end, with never another thought given to it until the following year. But the facts are otherwise at the Garden.

Stock plants of each variety needed for the following year must be kept and accurately labeled. The system of labeling the chrysanthemums is somewhat puzzling to the uninitiated. Since many of the varieties bear names of persons some visitors erroneously conclude that the plants have been brought to the show by those persons. The fact is that hybridizers long ago found it difficult to supply names for their numerous introductions, and while occasionally the name is descriptive, as "Gold Coin," which indicates the color, more often it is that of some member of the introducer's family. This accounts for the many "Mr." and "Mrs." and "Miss So-and-So" chrysanthemums. To the men who grow these plants the names are meaningless except that they help to separate the varieties. This is one of the tasks that requires a great deal of attention, particularly when the show is being dismantled. At this time all of the plants are cut back to the surface of the pot, and if it were not for the wooden label in each pot it would be impossible to separate and distinguish the varieties.

A "stock plant" is the root system of a chrysanthemum which has bloomed in November, and is kept for future propagation. Even before the plants have been cut down new shoots have developed at the surface of the soil, and these are the potential plants for the following season. The number of stock plants that must be kept depends upon the number of plants to be grown the following year and also upon the number of cuttings each particular variety yields. Unfortunately, some of the best varieties produce but few cuttings. The stock plants are kept in a cool greenhouse which is held at a temperature of about 45 degrees. In this house they are separated into their respective groups, of basket, cascade, Japanese, specimen, bush, and single-stem, and the varieties are arranged in alphabetical order to simplify the work when the cuttings are made.

The hanging-basket varieties are the first to be started. Cuttings are taken in early January. The plants are grown in pots during the spring months, and in June they are placed in the baskets in which they will bloom. When hanging-basket chrysanthemums were first displayed in 1920, the baskets were filled with full-grown plants just a few weeks before blooming. While that method of culture was fairly satisfactory, a new and better

SINGLE STEM CHRYSANTHEMUMS

CAT-TAIL BACKGROUND

one has gradually been developed. The large baskets, measuring eighteen inches in diameter, are planted near the rim with only four plants each. As the plants grow they are trained to hang over the sides of the basket. Thirty-six of the large baskets and twenty-four of the small ones are used each year. The three varieties, "Anna," "Jane Harte" ("Jean Hart"), and "Sam Caswell," are grown in the large and small baskets. The variety "Ladysmith" is used only in the small size, one plant to a basket. It is the finest variety for the purpose, but since it blooms early it must be replaced with another variety after the middle of November. All through the summer months these plants are grown in two special houses and in late October they are moved to the display house.

Each large basket weighs eighty-seven pounds, and while this is not a great weight the basket is bulky and awkward to handle. The method adopted is as follows: Three one-foot chains are fastened to a three-inch ring, the loose ends of the chain being hooked in the rim of the basket. Through the ring is passed a two-inch pipe eight feet long, by means of which two men, one at each end, raise the basket. A third man disengages the basket hook. With the pipe resting on their shoulders the two men carry the basket to the waiting truck. In the body of the truck are two wooden tripods supporting a pipe with two hooks. The basket is lifted into the truck, the ring with the three chains slipped over the hook, and the pipe withdrawn. Two baskets are carried in each truck. When possible the truck is driven directly under the chain where the basket is to hang in the display house.

Another group of chrysanthemums which is started early in the year contains the varieties known as "standards" and "specimen" plants. A standard is a plant with one stout stem which has been allowed to grow three or more feet high before being "stopped," the term used for this operation. The several branches that develop are then trained to form a symmetrical head, each branch producing one large flower. The specimen plant is similar, but instead of having one central stem several branches are started near the base, and one to several flowers are borne on each branch. The term "specimen" is also applied to the plants bearing many flowers carefully tied to a wire framework. These

FIELD OF BUSH CHRYSANTHEMUMS

LIFTING BUSH PLANTS

plants require a full season of careful pinching and training, tying to bamboo stakes, and frequent disbudding. The plants are started in 2½-inch pots and are finally shifted into 9, 10, and 12-inch pots.

In early February the Japanese varieties of chrysanthemums are started, and the method of training them is similar to that of the specimen plants. They are not robust-growing plants, and during the extremely hot months must be very carefully watered.

The single-stem chrysanthemum is the kind in which only one shoot is permitted to grow, bearing one large flower. The shape of the flower differs, some varieties having incurved petals and others reflexed. The cuttings of these single-stem varieties are taken in February and March, inserted in sand in the propagating bench, and after three weeks are potted into small pots. Their ultimate height depends upon the variety, the time the plants are started, and whether or not they have been pinched or "stopped." The 1500 single-stem chrysanthemums which are grown each year remain in the greenhouses during their entire growing period. From the time the cuttings are taken in February until they are displayed, they require daily attention. All of the plants are first potted into 2½-inch pots, later repotted into 4-inch pots, and in June they receive their final shift into 6-inch pots. This means that the 1500 chrysanthemums have been transported to the potting bench three times and that 4500 plantings have been made. No one, except the men who actually grow these plants, realizes the tremendous amount of work required to bring them into bloom. Soon after the plants are in their final pots they are staked with bamboo canes, and as they increase in height they are tied or clipped to these canes. Some varieties grow too rapidly and must be "stopped" by pinching the center and when lateral shoots develop all but one must be removed. In September and October the buds finally appear, and the grower is confronted with the problem of selecting either a "crown" or "terminal" bud. A crown bud is the first flower bud and is surrounded by lateral shoots which later develop flower buds. If the crown bud is removed these lateral growths develop and from them the best one is selected. This shoot ends in a flower bud which terminates the growth of the plant. Now is

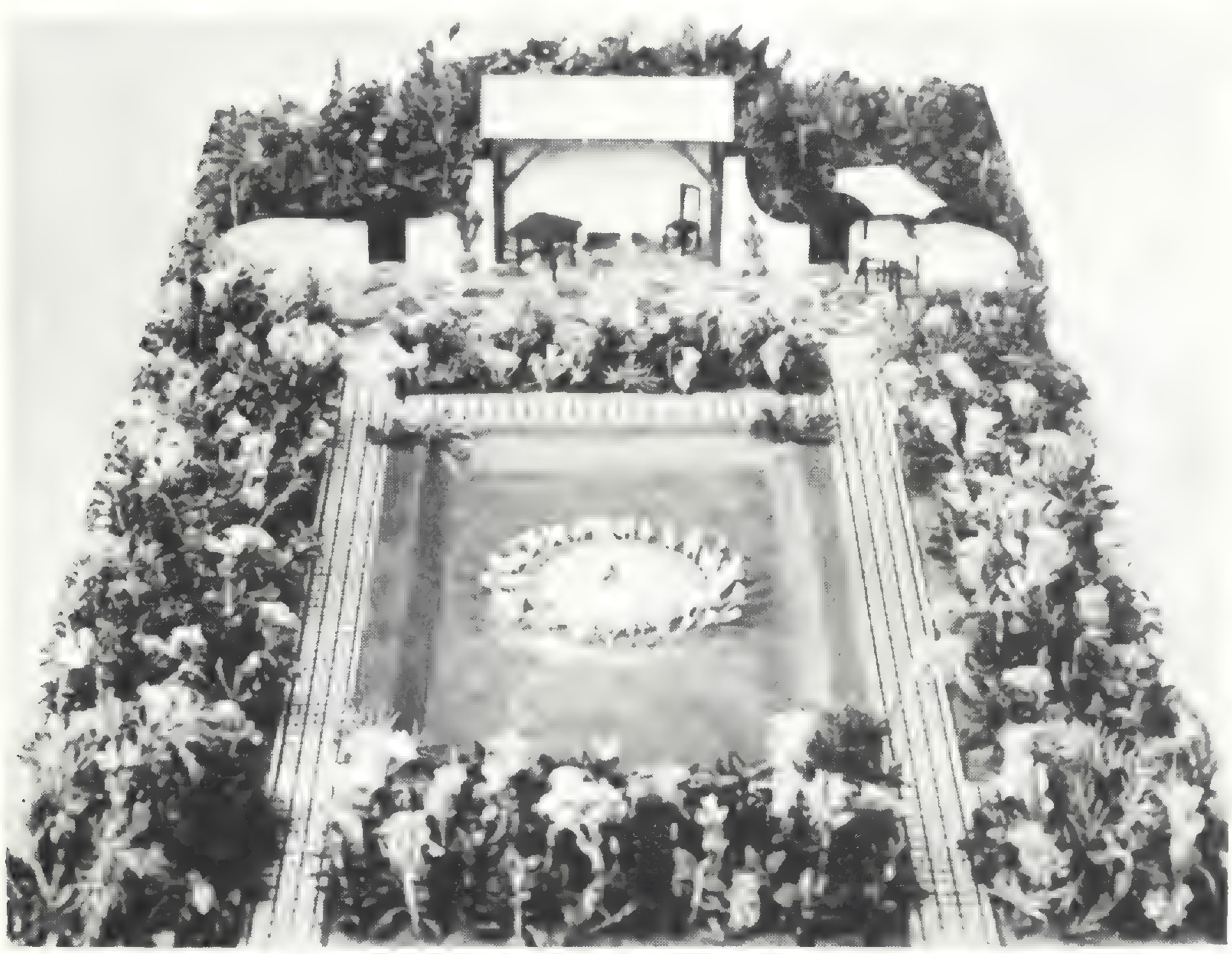
CASCADE CHRYSANTHEMUMS

BUSH CHRYSANTHEMUMS

the critical time in the life of each of these chrysanthemum plants for if the terminal bud is removed or broken the plant is lost. One daily operation that must never be neglected is watering and syringing the plants. A 90- to 100-degree temperature in the shade is a mild temperature compared to that in the greenhouses with the sun shining on the glass roof. It is during the periods of extremely high temperatures that the plants must be given the greatest care. Overwatering a chrysanthemum in a hot and humid atmosphere will soon bring its ruin. After the potting, watering, pinching, staking, and fertilizing have been attended to there is still one major operation that must not be neglected. The plants must be sprayed and fumigated for if this is not done regularly the insects and diseases will destroy the crop. The three worst insect pests are aphis, red spiders, and mealy bugs. Other insects to guard against are thrips, midge, lace bugs, tarnished plant bugs, leaf rollers, caterpillars, and grasshoppers. In brief, each of the 1500 single-stem chrysanthemums placed on display in November has had nine months of daily attention of one type or another.

The most novel manner of training any chrysanthemum is the so-called "cascade." This group has been featured at each fall show since 1930, the Garden being one of a very few places in the country making such an annual display. Varieties with thin and flexible stems make the best cascades. These mostly have single flowers although some varieties with semi-double and double flowers are used. Of the named varieties "Anna," "Jane Harte," and "Ladysmith" are the best. For variety a few "Adele Wallner," "Alice Howell," bronze and pink "Buckingham," "Christmas Gold," "Columbia," "Garza," "Radiant," "Wellington Wack," and "Yellow Daisy" are also grown. From a packet of seed of the mountain-type of chrysanthemum sown in 1930, sixteen varieties are still retained. Each year 150 to 200 of these cascade chrysanthemums are grown. The cuttings are taken in early January. After the plants have been repotted into 6-inch pots they are placed in a single row along the edge of a bench, preferably a north bench. When they are six inches high they are pinched. The best of the lateral shoots is kept for the leader and is tied to a bamboo cane inserted in the pot at an

CONSTRUCTING A CHRYSANTHEMUM SHOW



MODEL OF A FLOWER SHOW

angle of forty-five degrees and pointed north. At least once a week, from May until September 15, these plants must be pinched and tied. The repeated pinching of the lateral and sub-lateral shoots requires much skill and judgment. Some varieties may be freely pinched but others resent this operation and refuse to branch. The plants are watered, syringed, sprayed, and fed like any of the single-stem varieties. The first week in October the bamboo cane is removed from the leader and each plant is placed on a shelf with the pendent growth facing south.

The last and largest group of chrysanthemums to be propagated in February and March contains the bush varieties. Bush plants are created by pinching to induce branching, and these plants vary in height from ten inches to three feet. They may be grown either in the field or in pots. At the Garden the greatest number are grown in the field, being set out in nursery rows in May. They are cultivated, pinched, and weeded during the summer and potted into 7- or 8-inch pots in September. The task of caring for these plants is a big one, and seven men are required to tie, dig, transport, pot, and place the plants on the greenhouse benches. The first week after potting, these plants require frequent syringing, particularly in bright weather. When they become established they receive the same culture as the bush plants grown in pots. As some varieties would be slow to recover after being potted from the field, they are best grown in pots from the start. They must be repotted several times during the summer until they are finally in 7- and 8-inch pots. Aphis give less trouble in the field than in the greenhouse, but in recent years the leaf hoppers and particularly the tarnished plant bugs have damaged many plants. These sucking insects seek the tender tip of each shoot and suck the plant juices, at the same time injecting a poison which cripples the terminal growth and prevents flower buds from forming. Neither of these insects can be killed by spraying but must be discouraged as much as possible by clean cultivation and by the frequent use of repellents. This year 2,000 bush chrysanthemums have been grown in the field and 700 in pots, representing 125 varieties.

For many years flower shows were staged in the same stereotyped manner, the excellence of the plants being the only con-

sideration. With the growth of the flower-show movement in the various cities, particularly in the East, there gradually has developed a better and more artistic method of displaying the plants. The chrysanthemum shows have felt this change, and instead of the plants being grouped merely according to size and type they are now given a suitable setting. Chrysanthemums are always associated with the gardens of China and Japan, where they have been grown for many centuries, and it is only natural that some design, reminiscent of the Orient, should be chosen as a setting for the display. For the last ten years, as each chrysanthemum show at the Garden was planned, some Chinese or Japanese motif was selected around which the plants were assembled. Some of the motifs used in past years have been the Japanese lanterns and umbrellas, stone lanterns, Tori and moon gates, waterfalls and reflecting pools, with the ever-present storks, and tea houses. Many obstacles prevent the achievement of a complete design. The shape of the show is always limited by the rectangular area in the display house; the problem of handling several thousand people during a few hours on a Sunday afternoon necessitates walks of ample width; provision must be made for the watering of the plants as each chrysanthemum is grown in an individual pot; the hanging baskets must be arranged to avoid any water striking the plants beneath, and color harmony must be given consideration so as to create a satisfying and lasting impression. Some chrysanthemum varieties bloom in late October and others as late as December and a balance must be maintained between the early and late varieties so that replacements may be made.

An aerial plan for the basket varieties and a floor plan for the entire chrysanthemum show are drawn each year, and when necessary, models of the shows are constructed.

Cat-tails make an excellent rush background along the side walls. When these inverted stalks are nailed to a light wooden framework the tan color blends beautifully with the multi-colored chrysanthemums. Each cat-tail is approximately an inch thick, and thousands are required for several hundred feet of background. These are cut and cured in September and some weeks later the loose outer leaves are peeled. Just before building the

fence the butts of the cat-tails are cut on the slant with a pruning shear. With a small nail each stalk is tacked to the frame, and the long ends of the cat-tails, which formerly were the tops, are sheared off.

A chrysanthemum show requires two weeks to install. Much preliminary construction work must be done the first week. Framework for the backgrounds is erected; sometimes portions of the displays are elevated; pools are constructed; walls are stuccoed and bamboo fences are built. During the second week the chrysanthemums are arranged. The tall single-stem varieties are the first to be carried into the display house where much time is consumed in arranging them properly. The bush varieties are then arranged according to height and color. The cascade and Japanese varieties are usually kept in a group to themselves. The standard and specimen varieties are used as point plants. The baskets, as has previously been stated, are suspended from the roof, but in some years the small baskets are set on bamboo or rush-covered poles.

The purpose of this article has been to present all of the details involved in bringing together under one roof the chrysanthemum show, which has been the most popular floral display in St. Louis for many years. The show is open to the public on the first Sunday in November and is continued for four weeks.

P. A. K.

RIDDING THE GARDEN OF MOLES

Having recently come to grips with several lusty moles, it seems worth while to relate a few details of the encounter.

About the last of August the collection of rock-garden plants became inhabited with some very active moles. Apparently they decided that here at last was Utopia—soft, moist soil, lots of choice worms and insects, and always a safe, comfortable retreat behind the rocks. They worked day and night, so in practically no time the entire garden was honeycombed. Most of the plants were heaved out of the soil and many of them died because the roots were dried out by the sun. Mice and rats found the burrows most convenient and proceeded to eat the bulbs. Squirrels hopped

in and madly excavated the mole hills, no doubt thinking that a lot of appetizing bulbs were being hidden from them.

Something just had to be done to curb this destructive activity. Mole cartridges that produce dense fumes when ignited were tried in the burrows. Nothing happened except that one of the operators succeeded in getting a hand burned. Cyanide powder was placed in the burrows, but the moles worked twice as vigorously on the following day, and several plants died from the effects of the gas. Vicious-looking traps were set, but to no avail. So, armed with sharp spading forks, we kept a vigilant watch, especially at 11:00 a. m. and 3:00 p. m. when moles are supposed to be most active. Evidently they were aware of our presence, for all action ceased until nightfall. Moles seem to possess a keen sense of hearing, or else they are vibration-conscious, as it is quite difficult to get near the scene of operations without being detected. However, it can be done, and many moles have been harpooned and boosted out of the ground with a spading fork or shovel.

In a final effort to eradicate these tenacious creatures, the family limousine was parked near the rock garden and a long rubber hose carefully attached to the exhaust pipe. The free end of the hose was inserted into a freshly made burrow and a damp cloth tightly packed in around the hose to concentrate the exhaust fumes in the hole. Then the motor was started. Deadly carbon monoxide gas, given off by all gasoline engines, passed through the hose and into the burrows. By accelerating and choking the motor, dense bluish-white fumes were forced out the exhaust and the progress of the gas through the tunnels could be easily traced. If the runways were unobstructed, the effective penetration of the gas would be for a distance of at least fifty to one hundred feet. After pumping the fumes into the burrow for about five minutes, the hose was moved to another strategic spot, and the process repeated. In this way the entire garden was thoroughly permeated with carbon monoxide. Earthworms crawled hastily out of the soil, writhed in agony, and expired. Centipedes, beetles, sow-bugs, ants, etc., scampered hastily off in all directions. The moles vanished.

We are greatly pleased with the results of our experiment. Try it some time, but avoid deep inhalations of the exhaust fumes.

D. C. F.

NOTES

Mr. L. P. Jensen, Manager of the Garden Arboretum, has been reelected president of the Garden Club of Gray Summit.

Mr. Paul A. Kohl, Floriculturist to the Garden, acted as judge at the school-garden exhibit at the Walbridge School, October 6.

The September number of *Horticulture* (**16:** 358–359) contains an article on "Water-lilies" by Mr. George H. Pring, Superintendent of the Garden.

Mr. L. P. Jensen, Manager of the Garden Arboretum, has a report on "Roadside Development" in the May issue of *The Flower Grower,* and one on "Wild Life Conservation" in the September issue.

Mr. Russell J. Seibert, for several years assistant in botany in the Shaw School of Botany of Washington University, is spending the year in research at the Arnold Arboretum of Harvard University.

The article on "Plant Propagation" by Dr. David C. Fairburn, Horticulturist to the Garden, from the Garden BULLETIN (February and March, 1936) has been reprinted in the July, August, September and October issues of *Real Gardening.*

The September issue of *Garden Digest* (**10:** 14–16) reprinted the article on "Sansevierias as House Plants" from the June, 1937, BULLETIN, by Mr. Ladislaus Cutak, in charge of succulents at the Garden. Mr. Cutak is also the author of an article in the August number of *The Cactus and Succulent Journal* (**10:** 27), on "Succulents at the Greater St. Louis Flower and Garden Show."

The September number of the ANNALS OF THE MISSOURI BOTANICAL GARDEN has recently been issued with the following contents: "The Taxonomic Importance and Phylogenetic Significance of the Cephalodia of Stereocaulon," by George Thomas Johnson; "New Varieties and Forms from Missouri," and "Additions, Corrections and Revisions to the 'Annotated Catalogue of the Flowering Plants of Missouri,'" by Ernest J. Palmer and Julian A. Steyermark.

Mr. L. P. Jensen, Manager of the Garden Arboretum, has given the following talks: "The Value of a Garden Club to the Community," at Hermann, Mo., April 20, when the Garden Club of Hermann was organized; "Conservation of Native Plants," before the Lansdowne Garden Club of East St. Louis, May 5; "Roadside Development," before the St. Louis Naturalists' Club, May 28; "The Romance of Botany," July 31, near Sullivan, Mo., where Mr. Jensen assisted in the ceremony of opening a nature trail in the Meramec State Forest; "Fruit and Berry-bearing Trees and Shrubs for Landscape Effects and Bird Forage," before the group of horticulturists and arboriculturists at the convention of the American Institute of Park Executives, at Milwaukee, September 19-22.

Recent visitors to the Garden include: Dr. Gladys E. Baker, instructor in botany, Hunter College, New York City; Mr. L. J. Boerg, graduate assistant in dairy husbandry, Iowa State College, Ames; Dr. W. H. Camp, assistant curator, New York Botanical Garden, New York City; Dr. Hamilton H. Card, pelargonium specialist, LaMesa, Calif.; Mrs. W. B. Collom, plant collector, Payson, Ariz.; Dr. Francis Drouet, curator of cryptogamic botany, Field Museum of Natural History, Chicago; Mr. W. N. Guthrie, British vice-consul, St. Louis, and Mr. F. K. Officer, O.B.E., M.C., counsellor at the Australian Embassy, Washington; Dr. Harry J. Fuller, assistant professor of botany, University of Illinois, Urbana; Dr. Thomas Kerr, assistant cotton technologist, United States Department of Agriculture, Washington; Mrs. Will Lake, member Fort Worth Park Commission, and in charge of Fort Worth Botanic Garden; Dr. E. R. Spencer, professor of botany, McKendree College, Lebanon, Ill.; Dr. Julian A. Steyermark, assistant curator of the herbarium, Field Museum of Natural History, Chicago.

STATISTICAL INFORMATION FOR AUGUST AND SEPTEMBER, 1938

GARDEN ATTENDANCE:

Total number of visitors in July	29,950*
Total number of visitors in August	31,473
Total number of visitors in September	27,296

PLANT ACCESSIONS:

Total number of plants, bulbs, and packets of seeds received in August	75
Total number of plants, bulbs, and packets of seeds received in September	46

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought in August	7
Total number of books and pamphlets donated in August	173
Total number of books and pamphlets bought in September	10
Total number of books and pamphlets donated in September	288

HERBARIUM ACCESSIONS:

AUGUST

By Purchase—

Davidson, Mrs. S. B.—Plants of Panama	368
Degener, Otto—Plants of Hawaii	61
Erichsen, C. F. E.—"Lichenen, bes. Schleswig-Holstein" Halbzenturie XV and XVI, Nos. 701-800 inclusive	100
Gentry, H. S.—Plants of Mexico	120
Standley, P. C.—Plants of Costa Rica	400
Weigel, Theo. O.—Weese, "Eumycetes selecti exsiccati" Fasc. XXXII, Nos. 776-800 inclusive	25

By Gift—

Anderson, E.—Plants of the central United States	15
Brown, W. L.—Grasses of Missouri	19
Collom, Mrs. W. B.—Plants of Arizona	21
Cutak, L.—Plants of southwestern Texas	25
Greenman, J. M.—*Tragopogon pratensis* L. from New York	1
Hayward, W.—*Solanum elaeagnifolium* Caw. from Florida	1
Hubricht, L.—Plants of the central United States	47
Runyon, E. H.—Plants of Virginia	2
Stratton, R.—Plants of Oklahoma	2
Williams, L. O.—Plants of Mexico	8

By Transfer—

Lowenhaupt, B.—Plants of horticulture	38
Total	1,253

* This was incorrectly given as 6,552 in the September BULLETIN.

SEPTEMBER

By Purchase—

Goodspeed, T. H.—Plants of South America..... 103

By Gift—

Anderson, E.—*Tradescantia* and *Iris* from Michigan, Missouri, and Nebraska..... 13
Brenckle, J. F.—Plants of South Dakota..... 25
Florida Agricultural Experiment Station—Fungi of Florida 75
Heising, Clara—*Lespedeza Sieboldi* Miq. from horticulture 2
Martinez, E., Jr.—Plants of Colombia..... 20
Sante, Norma E.—*Sophronitis grandiflora* Lindl. from Brazil 1
von Schrenk, H.—Plants of New Hampshire and Indiana... 5

By Exchange—

Botanic Garden, University of Cluj—Plants of Roumania.. 220
Botanical Museum of Harvard University, by L. O. Williams—Plants of Mexico and the southeastern United States 16
Field Museum of Natural History—Plants of Missouri..... 113
New York Botanical Garden—*Mandevilla crassifolia* (Benth.) Woods. from Venezuela..... 1
Rancho Santa Ana Botanic Garden—Plants of California.. 98
Royal Horticultural Society's Gardens, Wisley, England—Plants of China and horticulture..... 100

By Transfer—

Beilmann, A. P.—Plants of horticulture..... 41
Fairburn, D. C.—*Asparagus plumosus* Baker from horticulture 1
Pring, G. H.—*Nymphaea colorata* Peter from horticulture.. 2

Total..... 836

STAFF
OF THE MISSOURI BOTANICAL GARDEN

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JESSE M. GREENMAN,
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EDGAR ANDERSON,
Geneticist

ERNEST S. REYNOLDS,
Physiologist

ROBERT E. WOODSON, JR.,
Assistant Curator of Herbarium

NELL C. HORNER,
Librarian and Editor of Publications

GEORGE H. PRING,
Superintendent

JOHN NOYES,
Consulting Landscape Architect

PAUL A. KOHL,
Floriculturist

WILLIAM F. LANGAN,
Chief Engineer

AUGUST P. BEILMANN,
Arboriculturist

JOSEPH LANGEN,
Assistant Engineer

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Horticulturist

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Plant Recorder

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ALBERT PEARSON,
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In charge of Exotics

LADISLAUS CUTAK,
In charge of Succulents

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Missouri Botanical Garden Bulletin

Vol. XXVI NOVEMBER, 1938 No. 9

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Missouri Botanical Garden Bulletin

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LABELING PLANTS PERMANENTLY

To derive the most pleasure and satisfaction out of gardening, one must know something about the names of the plants involved. But these names, especially the botanical ones, are bogies to many amateurs. It is not easy to assimilate such taxonomic jargon as *Helenium autumnale pumilum magnificum, Thalictrum aquilegifolium purpureum,* etc., and so the resourceful gardener will provide each kind of plant with an appropriate label, thereby avoiding enervating mental gymnastics, particularly when inquisitive visitors appear on the scene. However, scientific names get to be somewhat of a habit after a while. The more you see and use them, the easier they are to remember. Common names are of very limited value and often extremely confusing.

There is such a wide assortment of labels on the market that it is quite a problem to select the best kind to use. Aside from individual taste there are several important factors to be considered when purchasing plant labels.

1. *Adaptability.* By all means retain a sense of proportion. Dwarf plants require small markers, whereas tall vigorous subjects need larger, more conspicuous ones.

2. *Visibility.* A garden should not appear like a collection of tombstones in an antiquated cemetery. Large flashy prominent labels distract attention from the plants and ruin the whole picture.

3. *Permanence.* Practical garden labels must be relatively immune to climatic conditions. They should be very durable and the inscriptions remain distinctly legible for years. Labels usually get knocked around considerably in the garden and the fragile types are soon gone.

4. *Design.* Attractive markers of simple design are most desirable. Those with hinged tops, slip-over covers, detachable cards, etc., are a constant temptation to wandering urchins and rabid souvenir hunters.

5. *Attachment.* Labels should be convenient to handle, easy to place, and not too bulky. Stick labels that bend or buckle when pressed into the ground are an unmitigated nuisance.

6. *Cost.* For temporary use, cheap wooden stick labels for small plants and wooden tags for trees or shrubs are quite satisfactory. Perennial service in the garden, however, demands more durable kinds which may range in price from a few cents to a dollar or more apiece. In this case selection will of course be governed largely by the family budget, but at any rate quality is seldom found on the bargain counter.

For a number of years samples of various commercial and home-made labels have been accumulating at the Garden. Most of these are illustrated in plates 22 to 26. With such a variety on hand it was decided that an endurance contest was in order to determine which ones would hold up best when exposed to St. Louis climate. Plate 21 shows the markers before and after one year's weathering (July 25, 1937-July 25, 1938). At first glance it is apparent that nearly all of the small stick labels in the foreground were heaved entirely out of the soil by frost. Most stick labels less than six inches long are subject to the heaving action of alternate freezing and thawing, and generally get lost in the spring clean-up. One of the heavy metal stick labels went down for the count but undoubtedly would have remained upright if it had been pressed deeper into the soil. A few of the dwarf markers suffered from finger-blight, a most aggravating condition that invariably occurs whenever the general public is allowed too much rope. Complete details of the test will be found in tabular form in the descriptions of the labels illustrated in plates 22 to 26.

In a botanical garden, markers are important for displaying the names of the plants and for experimental records. The ones now in use at the Missouri Botanical Garden are illustrated in plate 22. This assortment includes both permanent and temporary labels, representing selections made over a period of many years. For permanent labeling of trees, shrubs, and potted plants the names

are stamped into copper and zinc (pl. 22, figs. 6, 9, 10, 21, 23, 24), or molded on durable alloy (pl. 22, figs. 1, 4, 11, 19). The letters are stamped into the copper and zinc by a machine similar to a typewriter. The molded labels are purchased ready-made. Green pyralin labels, lettered with India ink, and coated with spar varnish (pl. 22, fig. 2) are used in conservatories and for seasonal displays outdoors. They are very easy to read and have a neat appearance when placed in metal holders (pl. 23, fig. 1). However, the lettering gradually fades and has to be renewed each year. The pyralin can be purchased in large sheets, making the cost of this home-made product quite negligible.

A considerable number of zinc labels inscribed with chemical or corrosive ink are used at the Garden. They may need an occasional washing to remove grime and products of oxidation, but the lettering remains legible for ten or more years unless exposed to abrasives.

A solution of platinum tetrachloride is generally used for writing on zinc. However, if many labels are to be prepared, this may be quite expensive. For many years the Garden has used a substitute which has proved to be entirely satisfactory. Directions for making this ink, previously given in the February, 1932, number of the BULLETIN, are as follows:

Procure a wide-neck bottle with a glass stopper. Fill it half full of new copper chips, such as may be obtained from a tinsmith. Add commercial muriatic acid to fill the bottle and allow the mixture to stand for eight weeks. During that time the color of the fluid will gradually change from bright amber to a cloudy dark emerald green and will finally become clear. After the eighth week pour off the clear acid from the copper chips, the liquid then being ready for use as ink. Unless the zinc label is thoroughly cleaned with a fine-grade emery paper to remove grease and finger marks the ink will not penetrate, while the cleaner the label surface the blacker will be the writing. To remove the writing use muriatic acid, then rub with a rough emery paper, finally polishing with a very fine emery paper. While a gold pen may be used with the platinum tetrachloride, it is necessary to use a glass pen with the substitute ink.

Inexpensive wooden stick labels are used at the Garden for

potted plants, seed-pans, flats, and cold-frames. They are definitely temporary, the wood being subject to rot as well as breakage, and the lettering, whether it be in soft lead pencil, India ink, or special weather-proof pencil, generally fades out in a year or two, particularly if the wood is unpainted. Wooden tree labels with copper wire attachment are also fragile and of fleeting value.

Stout wooden stakes, 2½ inches wide and about 2 feet long, cut from a 2-inch pine or cypress plank, are useful for marking nursery rows and experimental plots. The stake is sharpened at one end and given two coats of aluminum paint. Lettering can be done with special black paint made from lamp black and oil. Stamped zinc or copper tags nailed on the stakes are practically infallible. Painting preserves the wood.

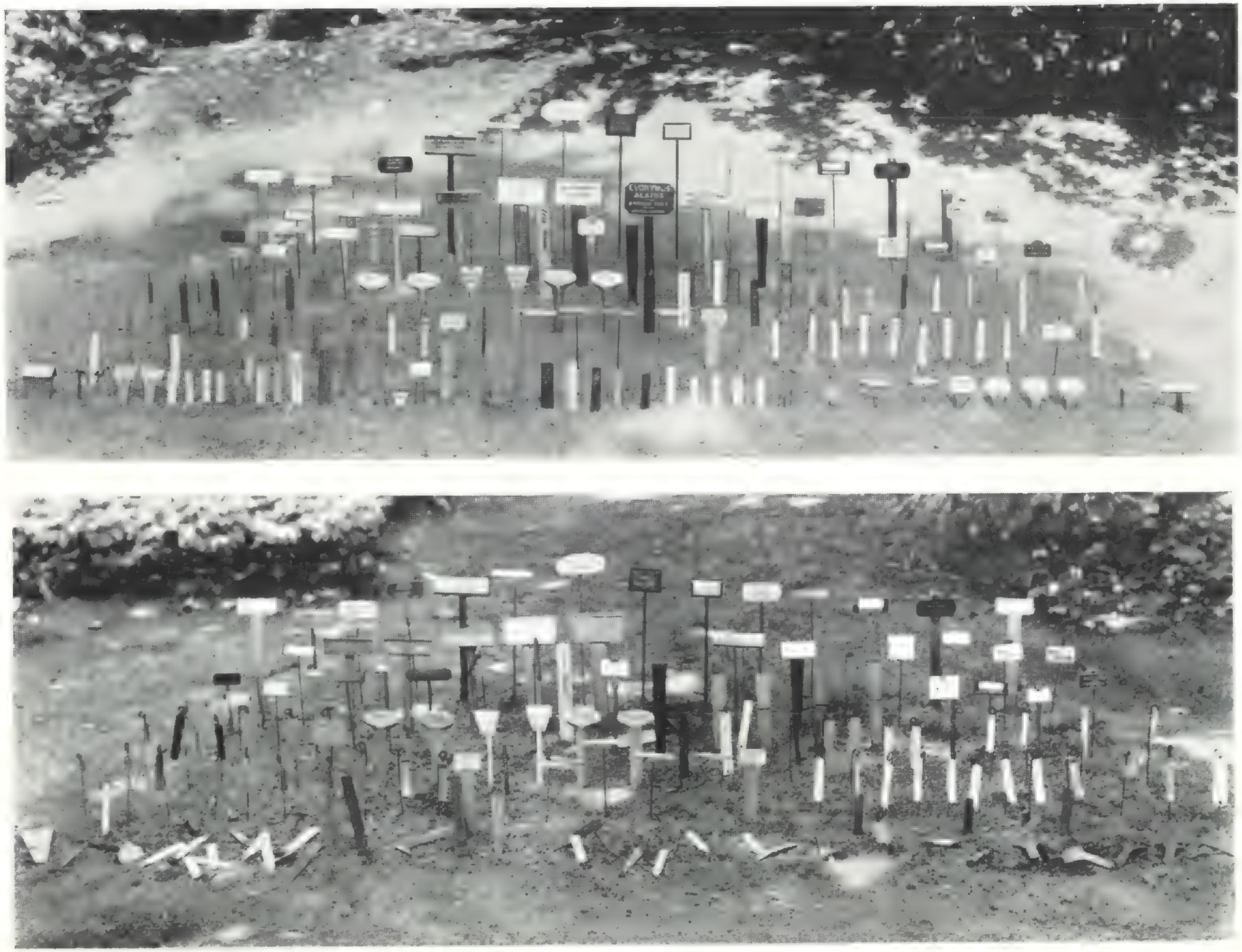
Thin sheet lead, cut to size and inscribed with a metal stylus, makes a very durable label. Lead is immune to weathering and the inscriptions will remain legible indefinitely.

Another kind of inexpensive label can be easily made by cutting sheet zinc to size. A hole is punched in one or both ends in which heavy galvanized wire is inserted for attaching the tag directly to the plant. The lettering is best done with chemical ink.

A stamped zinc or copper tag with a generous length of copper wire makes a good label for trees. The wire is looped around a limb of the tree and should be long enough to permit twisting several spring-like coils into the loop. As the limb grows in diameter the coiled wire straightens out and any possibility of the wire cutting into the bark is thus avoided.

And just at the finish, here comes a sample of another label in the morning's mail. It is a heavy glass tube about ½ inch in diameter and 3 inches long. At one end is a copper wire for attachment, the other end being plugged with a rubber stopper. Inside the tube is a roll of white paper on which to inscribe the name of the plant. This label looks very nice, but how long will it last? Glass seems to break on the slightest provocation, rubber stoppers disintegrate, and there are always treasure hunters on the lookout for such attractive little trophies.

D. C. F.



Labels at the beginning of test (upper cut), and one year later (lower cut), showing effect of frost heaving.

PLATE 22

TEST RATINGS OF LABELS ILLUSTRATED IN PLATES 22 TO 26. BASED ON ONE YEAR'S EXPOSURE TO ST. LOUIS WEATHER

Label No.	*Description of Label*	*Rating*	*Remarks*
1	Cast alloy, raised letters	*Excellent	Made in England
2	Home-made, green pyralin, India ink,** varnished	Fair	Temporary, needs refinishing every year
3	Same as No. 2, clothes-pin attachment	Fair	Temporary, needs refinishing every year
4	Same as No. 1, attached with screws, nails, or wire	Excellent	Refer to No. 1
5	Same as No. 2, galvanized wire holder	Fair	Refer to No. 2
6	Stamped copper plate, wired to galvanized rod	Excellent	Good for records, hard to read at distance
7	Zinc plate, copper wire	Fair	Corrosive ink lettering
8	Pliable zinc bent to shape	Fair	Refer to No. 7
9	Same as No. 8, but with stamped raised letters	Excellent	Refer to No. 6
10	Zinc tag, stamped raised letters, copper wire	Excellent	Refer to No. 6
11	Same as No. 1, attached with screws or bolts	Excellent	Refer to No. 1—used for trees
12	6-inch wooden stick label, painted on one side	Poor	Not dependable outdoors
13	8-inch wooden stick label, unpainted	Poor	Not dependable outdoors
14	Same as No. 13, but larger	Poor	Not dependable outdoors
15	Home-made, zinc tag, stamped letters, copper wire	Excellent	Refer to No. 6
16	Home-made, green pyralin tag, copper wire	Fair	Refer to No. 2
17	Home-made, copper tag, stamped letters, copper wire	Excellent	Refer to No. 6
18	18-inch wooden stake	Poor	Refer to No. 12
19	Same as No. 1, attached with screws or bolts	Excellent	Refer to No. 1
20	Wooden tag, painted	Poor	Refer to No. 12
21	Copper plate (new), stamped letters, copper wire		Refer to No. 22
22	Same as No. 21, but weathered for 1 year	Excellent	Refer to No. 6
23	Copper, stamped letters	Excellent	Refer to No. 6
24	Copper plate, stamped letters, bolt attachment	Excellent	Refer to No. 6—used for trees

* Excellent = no appreciable deterioration. Good = slightly weathered but perfectly legible. Fair = barely passable, lettering partially destroyed. Poor = lettering entirely faded out, for temporary use only.

** All the labels tested were lettered with India ink unless otherwise indicated.

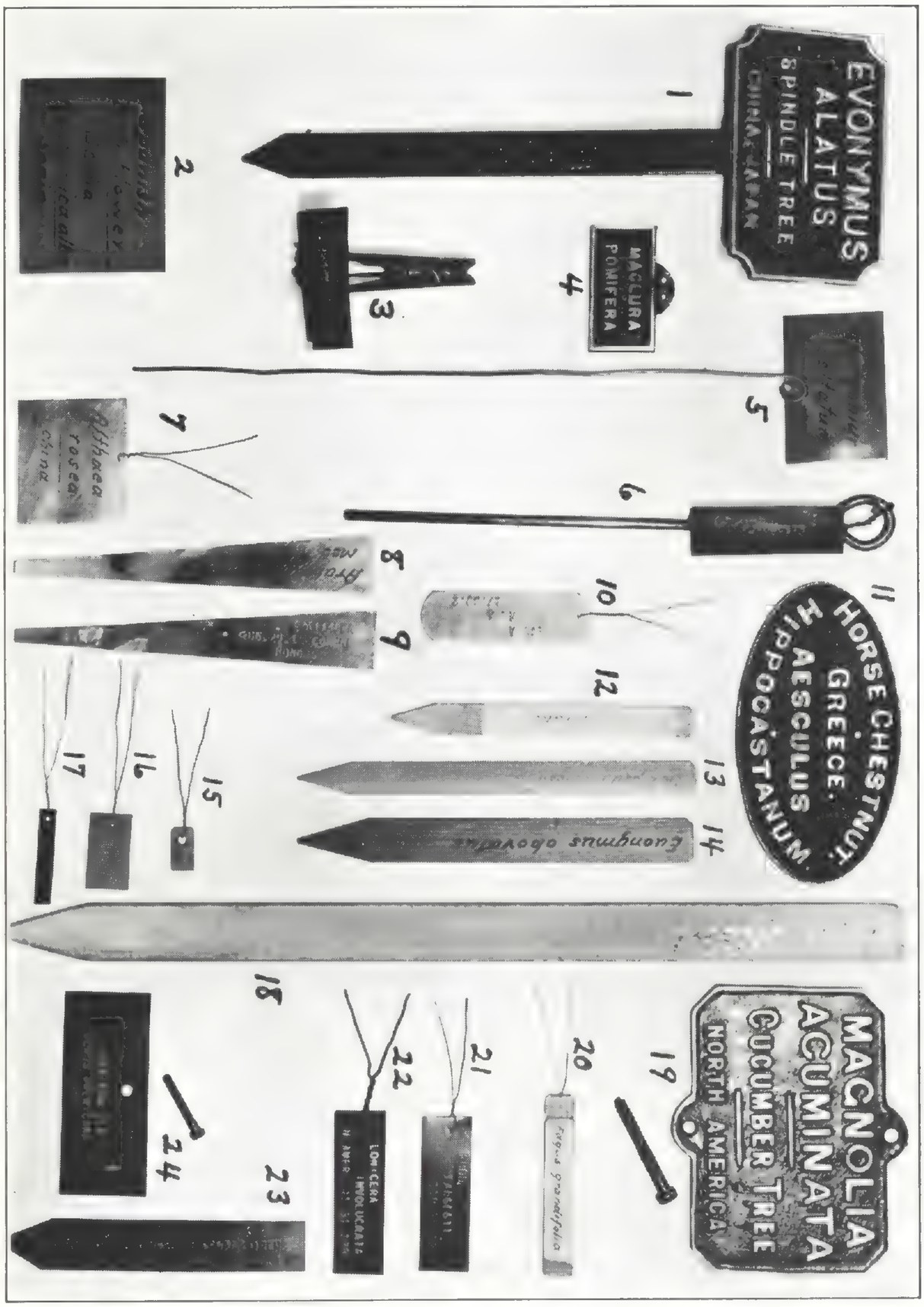

EVONYMUS
ALATUS
SPINDLE TREE
CHINA JAPAN
MACLURA
POMIFERA
HORSE CHESTNUT
GREECE.
AESCULUS
HIPPOCASTANUM
MAGNOLIA
ACUMINATA
CUCUMBER TREE
NORTH AMERICA
Euonymus obovatus
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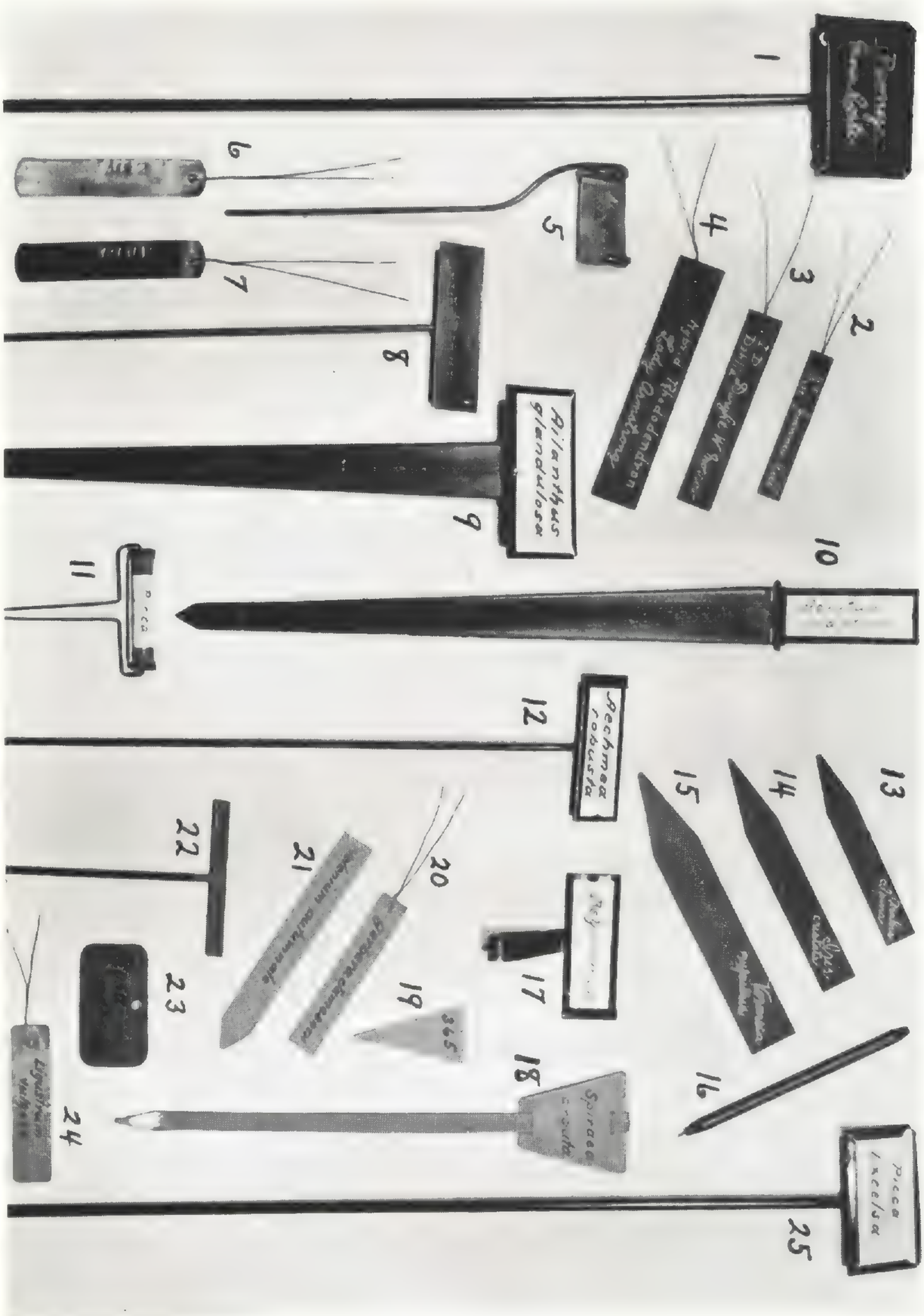
PLATE 23

Label No.	*Description of Label*	*Rating*	*Remarks*
1	Metal holder, green celluloid card marked with special steel stylus	Good	Color faded, metal holder slightly rusted
2	Green celluloid tag, white letters marked with steel stylus	Excellent	Green color slightly faded
3-4	Same as No. 2, only larger size	Excellent	Green color slightly faded
5	Galvanized wire holder, zinc name-plate	Fair	Permanent if lettered with chemical ink
6	Flexible zinc tag, lettered with hard pencil	Excellent	Difficult to read at reasonable distance
7	Same as No. 6, but tag made of copper	Excellent	Difficult to read at reasonable distance
8	Zinc plate on galvanized wire stake	Fair	Refer to No. 5
9	Metal holder, white card insert	Poor	Lettering completely gone, metal rusted
10	Same as No. 9, but with hinged top	Good	Metal rusted
11	Glass tube corked at ends, paper insert, wire holder	Poor	Heaved out of ground, paper streaked with rain and soot
12	Metal holder, white card insert	Poor	Refer to No. 9
13	Green celluloid, white letters inscribed with steel stylus	Excellent	Heaved out of ground by frost
14-15	Same as No. 13, only larger size	Excellent	Heaved out of ground by frost
16	Special steel stylus for marking green celluloid		
17	Metal clip for potted plants, etc., white card insert		(Souvenir hunters got this one)
18	Green celluloid, 2-piece label	Good	Color slightly faded
19	Green celluloid tag	Good	Color slightly faded
20	Green celluloid, copper wire attachment	Good	Color slightly faded
21	Green celluloid		Refer to No. 17
22	Metal, green name plate	Good	Color faded
23	Heavy green celluloid, screw, nail, or wire attachment	Excellent	Color slightly faded, made in Germany
24	Zinc tag, copper wire attachment	Good	Refer to No. 5
25	Metal holder, white card insert	Fair	Letters partly obliterated, holder rusted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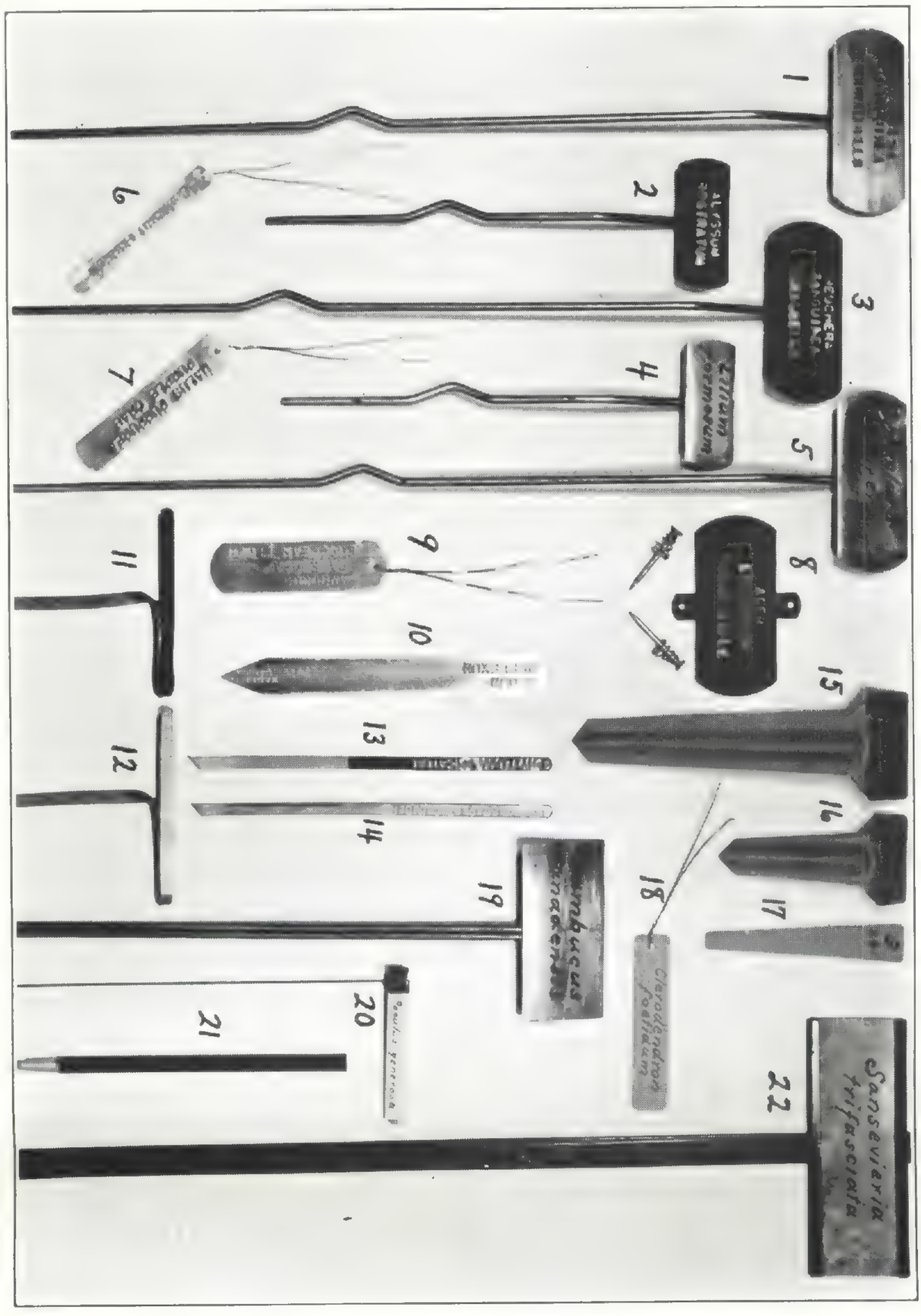
Alianthus glandulosa
Pinus Picea

PLATE 24

Label No.	*Description of Label*	*Rating*	*Remarks*
1	Zinc, stamped raised letters	Excellent	Rather hard to read at a distance
2	Galvanized steel, name-plate painted black, stamped letters	Excellent	Paint slightly weathered
3	Same as No. 2, only larger	Excellent	Paint slightly weathered
4	Same as No. 1, but lettered with India ink	Fair	Metal a trifle rusted
5	Same as No. 4, only larger	Fair	Metal a trifle rusted
6	Zinc tag, stamped letters, copper wire attachment	Excellent	Refer to No. 1
7	Same as No. 6, only larger	Excellent	Refer to No. 1
8	Galvanized steel, stamped letters, nail or screw attachment	Excellent	Refer to No. 2
9	Zinc tag, stamped letters, copper wire attachment	Excellent	Refer to No. 1
10	Zinc, stamped letters	Excellent	Refer to No. 1
11	Pliable lead painted black, impressed letters painted red	Excellent	Heaved out of the ground, made in England
12	Same as No. 11, but with natural finish	Excellent	Heaved out of the ground, made in England
13	Same as No. 11, but upright type	Excellent	Splendid for rock-garden plants, made in England
14	Same as No. 12, but upright type	Excellent	Splendid for rock-garden plants, made in England
15	Green celluloid	Good	Letters partly faded
16	Same as No. 15, but smaller		(Souvenir hunter's trophy)
17	Green celluloid	Good	Heaved out of soil, best for potted plants, flats, etc.
18	Green celluloid, copper wire attachment	Good	Color slightly faded
19	Zinc name-plate on heavy galvanized wire	Fair	Permanent if lettered with chemical ink
20	Celluloid tube with cork, paper card insert, wire holder	Poor	Celluloid cracked, lettering streaked with soot
21	China marking pencil for writing on glass, metal, etc.		
22	Metal holder painted olive-green, special cardboard insert	Poor	Paper card severely weathered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Sansevieria trifasciata

PLATE 25

Label No.	*Description of Label*	*Rating*	*Remarks*
1	Zinc tag, stamped letters, wired on heavy wire holder	Excellent	Rather hard to read at a distance
2	Flexible zinc, may be bent into desired shape	Fair	Permanent if lettered with corrosive ink
3	Home-made zinc label, top reinforced with wood	Good	Heaved out of the ground
4	Home-made zinc tag, copper wire attachment	Good	Refer to No. 2
5	Heavy copper, impressed letters painted white	Excellent	Refer to No. 1
6	Galvanized metal holder, removable wooden tag enclosed in slot	Poor	Severely weathered
7	Galvanized holder, white card insert	Poor	Severely weathered
8	Same as No. 7, but with pliable metal insert, letters impressed with pencil	Good	Refer to No. 1
9	Zinc (also available in galvanized metal)	Good	Refer to No. 2
10	Galvanized metal (also available in zinc)	Good	Galvanized metal, may rust in time
11	Zinc holder with telescopic top covering white card insert (also available in galvanized metal)	Good	Removable tops apt to get lost in public parks
12	Removable zinc name-plate on galvanized wire	Good	Refer to No. 2
13	Zinc tag on wire holder	Good	Holder slightly rusted
14	Zinc tag, copper wire attachment	Good	Refer to No. 2
15	Same as No. 14, but larger size	Good	Refer to No. 2
16	Zinc tag on wire holder	Good	Wire holder rusted
17	Metal holder, green marble insert	Poor	Metal rusted
18	Removable zinc name-plate on wire holder	Fair	Metal rusted

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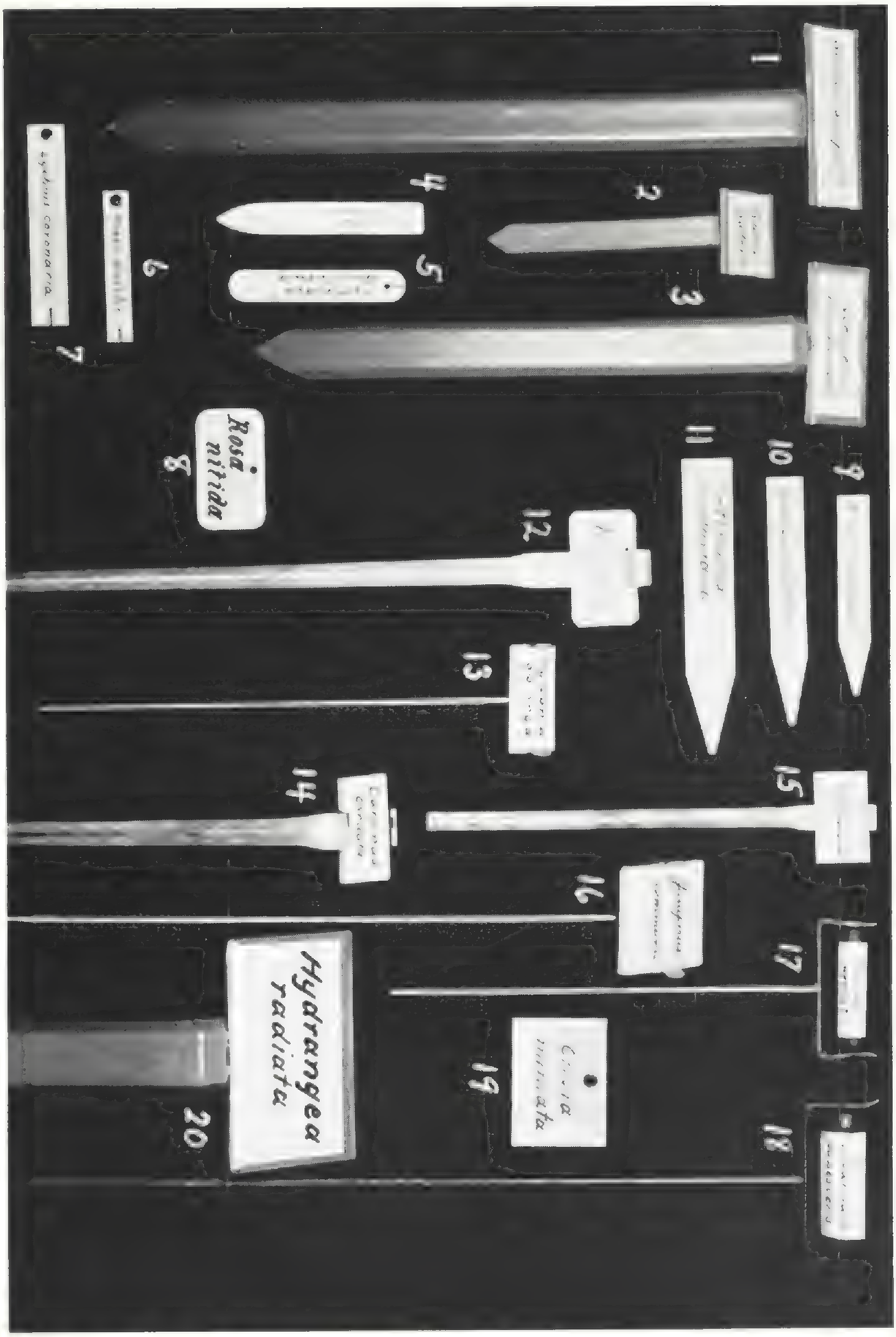
Bertholletia excelsa
Cotoneaster rotundifolia Himalaya
Fittonia gigantea
Ferocactus uncinatus

PLATE 26

Label No.	*Description of Label*	*Rating*	*Remarks*
1	Metal holder painted green, white card insert	Fair	Color faded
2	Same as No. 1, but smaller size	Fair	Color faded, heaved out of ground
3	Same as No. 1, but with glass cover over name-plate	Poor	Soot and moisture accumulated under glass
4	White pyralin	Fair	Heaved out of soil, label too flexible
5	White pyralin, copper wire attachment	Fair	Too flexible
6	White celluloid, mica cover, wire attachment	Fair	Refer to No. 3
7	Same as No. 6, but larger size	Fair	Refer to No. 3
8	Heavy white celluloid, screw, nail or wire attachment	Excellent	Made in Germany
9	White celluloid	Good	Heaved out of the ground
10-11	Same as No. 9, but larger size	Good	Heaved out of the ground
12	Galvanized holder, white celluloid name-plate	Fair	Name-plate flaps in breeze
13	Metal holder, white marble insert	Poor	Holder rusted
14	Galvanized holder, white marble insert	Poor	Marble does not retain ink
15	Same as No. 12, but smaller size	Fair	Refer to No. 12
16	Same as No. 13, but larger size	Poor	Refer to No. 13
17	Metal holder, glass tube, rubber caps, white paper insert	Good	Paint on metal weathered
18	Same as No. 17, but larger size	Good	Paint on metal weathered
19	Home-made white celluloid, screw, nail or wire attachment	Good	Letters streaked with rust from wire holder
20	Metal holder painted green, white card insert, glass cover	Fair	Refer to No. 3


Rosa nitida
Hydrangea radiata

AN EXOTIC CROTALARIA AT HOME IN ST. LOUIS GARDENS

In recent years interest has been growing in the horticultural possibilities of a large, conspicuously flowered legume which has become established in the southeastern lowland region of Missouri. Having been grown with success in a number of St. Louis gardens, curiosity as to its identity, origin, and history in this part of the country has been aroused.

The genus Crotalaria—commonly known as Rattle-box due to a propensity of the seeds to become loose within the pod at maturity—consists chiefly of tropical herbs with a few representative species in temperate regions of both the Old and the New Worlds. To one acquainted with *C. sagittalis* L., the predominant species in North America, its relationship with the showy plant under discussion is somewhat surprising. But the latter has been definitely determined as *C. spectabilis* Roth, native of India and the East Indies, occurring also in the Hawaiian Islands and throughout the West Indies whence it became established in the sandy soils of peninsular Florida and the Keys. Exotic species of Crotalaria have been cultivated as cover crops for some time; but in recent years the use of *C. spectabilis* has spread throughout the South due largely to its introduction by the Experiment Station of the University of Florida. In a number of instances it has escaped cultivation and become naturalized. Such has been the case in southeastern Missouri where its popularity as a silage plant is steadily increasing.

A closely allied species, *C. retusa* L., is frequently confused with *C. spectabilis* Roth. It has virtually the same distribution and has also been widely cultivated. Similar in general habit, it is a smaller plant with somewhat larger flowers which frequently show a purplish cast in contrast to the brighter yellow of *C. spectabilis*. This feature, however, is not sufficiently constant to be reliable. Aside from the differences in size, the most obvious delimiting characters lie in the small leaf-like structures which occur singly below the individual flowers and in pairs at the base of the leaves. They are minute and have a tendency to wither and drop off early in *C. retusa*, but are conspicuous and persistent in *C. spec-*

Fig. 1. *Crotalaria spectabilis* Roth.

Fig. 2. *Crotalaria retusa* L.

Both illustrations represent an early flowering stage. The racemes attain a length of 1½ to 2 feet.

tabilis. Both species show considerable promise as hardy perennials for the informal garden, their soft green foliage creating a pleasing background for the profusion of large yellow blossoms borne loosely on long terminal racemes. MAXINE LARISEY.

WINTER COURSES IN GARDENING FOR AMATEURS

ELEMENTARY COURSE

The elementary course in various phases of gardening for amateurs, which has been conducted at the Garden for the past few years, will be repeated in 1939. As formerly, it will commence in January, since it is believed that the course is of more value when given earlier in the year. The class will meet in the lecture room of the museum building (entrance at Tower Grove and Cleveland Avenue gate) at 3:45 p. m., Monday of each week.

REGISTRATION: It is desirable that registration be made by letter, with check enclosed payable to the Missouri Botanical Garden, as soon after December 20 as possible. Tickets will be ready for distribution on day of first lecture. Registration fees will also be received on January 9 at the lecture hall, at 3:00 o'clock.

FEE: The registration fee is $5.00 for each person, and tickets are not transferable.

The outline of the subjects to be discussed follows:

January 9—Brief discussion of catalogues, horticultural magazines, and bulletins. Illustrated lecture on rock gardens and bulbs....Kohl

January 16—Trees and shrubs:
Pruning of shrubs at planting time.....Beilmann

January 23—Annuals, perennials. Illustrated lecture.....Kohl

January 30—The general care of trees:
Surgery.
Fertilizers.
Cabling.
Transplanting.....Beilmann

February 6—Roses. Illustrated lecture.....Kohl

February 13—Lawns:
Seed lawns: Preparation of the soil, seed selection, fertilizers.
Stolon lawns: Methods of planting by means of stolons and plugging.
Lawns and their subsequent care.....Pring

February 20—Raising plants from seed. The students will sow seeds of annuals and perennials in the greenhouses, later transferring the plants to their own gardens. Students will furnish their own seeds ..... Fairburn

February 27—Iris and peonies. Illustrated lecture..... Kohl

March 6—Controlling insect pests. Material to use..... Beilmann

March 13—Water gardens. Illustrated lecture.
Construction of pools.
Preparation of soil and planting.
Caring for hardy and tropical water-lilies during growing season.
Propagation by seeds, tubers, leaves.
Breeding.
Winter storage..... Pring

March 20—The home culture of cacti and other succulent plants.
Illustrated lecture:
Kinds for the beginner to grow.
Soil, air, light, temperature, and moisture.
Propagation by seed, cuttings, and grafting..... Cutak

March 27—The students will pot up the plants raised from seed sown Feb. 20. These plants will remain in the greenhouses until the weather permits the class members to set them out in their own gardens ..... Fairburn

ADVANCED COURSE

The advanced course in gardening for amateurs will start February 2. The purpose of this course is to give the students as much practical work as possible. All of the classes will be held in the experimental greenhouses from 10:00 to 12:00 a. m., Thursday of each week. The course will be in charge of Dr. Fairburn.

REGISTRATION: Enrollment limited to 40 students. The elementary course or previous gardening experience is a prerequisite to this advanced course.

FEE: The registration fee is $10.00 per student and tickets are not transferable. Write or phone the Garden, Pr. 5567, for reservations.

February 2—The selection and care of house plants:
Exhibit of desirable house plants. How to grow them successfully. Forcing of bulbs.

February 9—Soil management:
The characteristics of "good" soil. Study of drainage and demonstration of soil testing. Preparation of fertile garden soil.

February 16—Fertilizers:
How to improve soils by the use of fertilizers. The students will start an experiment in the greenhouse to show the effects of various fertilizer treatments on plant growth.

February 23—Insects and diseases:
Identification, control and injury caused by common garden pests. Exhibit of harmful insects, diseases, injury to plants, insecticides, fungicides, sprayers, dusters, etc. Books and bulletins on plant pests.

March 2—March 30—Plant propagation:
The propagation of plants is one of the most important and interesting phases of gardening. Five class periods will be devoted to this subject in order that the students may become familiar with a wide variety of plants and their methods of increase.

a. Seed.
b. Stem cuttings.
c. Leaf cuttings.
d. Root cuttings.
e. Hardwood cuttings.
f. Rootstocks or rhizomes.
g. Tubers.
h. Tuberous roots.
i. Bulbs, bulb scales, corms, cormels.
j. Viviparous leaves.
k. Stolons.
l. Layering.
m. Grafting, budding.

April 6—Potting of plants raised from seed.

April 13—Potting of plants raised from cuttings.

April 20—Landscaping the home grounds:
The selection, arrangement, and care of trees, shrubs, and flowers. Lawns.

April 27—Survey of garden books and bulletins. Practical demonstrations of planting small trees, shrubs, annuals, and herbaceous perennials.

May 4—Trip to the Garden Arboretum at Gray Summit where the students will have an opportunity to see the large collection of orchids, the pinetum, the nursery, and much of the native flora.

NOTES

Mr. L. P. Jensen, Manager of the Arboretum, acted as judge at the flower show staged by the Garden Club at Hermann, Mo., October 12.

Dr. Burr N. Prentice, head department of forestry, Purdue University, Lafayette, Ind., and a group of his students visited the Garden Arboretum, October 29.

Mr. Paul A. Kohl, Floriculturist to the Garden, gave an illustrated lecture on "Roses" before the Normandy Circle of the Rose-Mary Garden Club, Normandy, Mo., October 1.

Mr. Ladislaus Cutak, in Charge of Succulents at the Garden, has an article in the October number of *Desert Plant Life* (**10:** 88) entitled "Succulents Merit a Trial in the Home."

The November issue of *Garden Life* contains an article by Mr. L. P. Jensen, Manager of the Arboretum, on "Fruit and Berry-bearing Trees and Shrubs for Landscape Effects and Forage for Birds."

Mr. Ladislaus Cutak, in Charge of Succulents at the Garden, gave an illustrated lecture "Exploring Texas with Camera and Tripod," before the St. Louis Camera Club at the St. Louis Public Library, November 16.

Mr. George H. Pring, Superintendent of the Garden, spoke before the Rotary Club of Belleville, Ill., November 1, on "The Romance of the Plant World," and before the Cape Girardeau Garden Club, Cape Girardeau, Mo., October 24, on "Chrysanthemums."

Dr. David C. Fairburn, Horticulturist to the Garden, gave a talk before a group of amateur gardeners at the Walbridge School, November 1, on "House Plants." On November 2, he spoke before the elementary botany class at Washington University on "Forcing Hardy Bulbs."

Mr. L. P. Jensen, Manager of the Arboretum, gave a talk before the Gray Summit Garden Club, October 2, on "Ornamental Fruit and Berry-bearing Trees and Shrubs," and before the State Federation of Garden Clubs, at Cuba, Mo., November 1, on "Conservation and Planting along the Roadsides."

Recent visitors to the Garden library and herbarium include Dr. Mary Goddard, assistant professor of botany, Southern Illinois State Normal University, Carbondale; Dr. F. L. Wynd, assistant professor of botany, University of Illinois, Urbana; Dr. G. W. Martin, professor of botany, University of Iowa, Iowa City; Mr. William C. Knight, student in botany, University of Missouri, Columbia; Mr. R. A. Ryter, teacher at the Mission School, Lolodorf, Cameroun, West Africa; Mr. Fred Gibson, director Boyce Thompson Southwest Arboretum, Superior, Ariz.; Dr. George C. Andrews, chief of clinic, department of dermatology, Vanderbilt Clinic, College of Physicians and Surgeons, New York City; Dr. T. Benedek, instructor in dermatology, Northwestern University, Evanston, Ill.

STATISTICAL INFORMATION FOR OCTOBER, 1938

GARDEN ATTENDANCE:

Total number of visitors	38,991

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	17
Total number of books and pamphlets donated	343

PLANT ACCESSIONS:

Total number of plants received	290
Total number of plants and packets of seeds received	110

HERBARIUM ACCESSIONS:

By Purchase—

Kay's Photo & Optical Company—Photographs of *Senecio*	2
Williams, L. O.—Orchids of Mexico	150

By Gift—

Anderson, E.—Plants of Missouri	3
Andrews, H. N. Jr.—*Polytrichum commune* L. from Belgium	1
Clemens, M. S.—Plants of New Guinea	6
Cutler, Hugh C.—Plants of Texas and Arizona	13
Dodge, C. W.—Mosses from Costa Rica	4
Erwin, A. T.—*Cucumis Melo* L. from horticulture	1
Heising, Clara—*Paulownia tomentosa* (Thunb.) Baill. from horticulture	1
Hildebrand, Mrs. W. J.—*Bidens* sp. from Texas	1
Instituto Miguel Lillo, Tucumán, Argentina—Lichens of Argentina	64
Kellogg, John H.—*Ascyrum hypericoides* L. from Missouri	1
Lodewyks, Maude C.—*Crotalaria sagittalis* L. from Missouri	2
Roush, Mrs. Eva M. Fling, by R. E. Woodson, Jr.—*Lycopodium* from West Virginia	7
Smith, A. C.—Plants of British Guiana	28
Williams, L. O.—*Hintonella mexicana* Ames from Mexico	1

By Exchange—

Agricultural Experiment Station, Gainesville, Florida—Liverworts and mosses from Florida	40
Barkley, Fred A.—Plants of Montana	13
Botanical Survey, Lingnan University, Canton, China—Plants of China	346
Field Museum of Natural History—Photographs of type specimens of *Costus*	37
Kew Herbarium—Fragments of South American Senecios	7
University of Arizona, by R. A. Darrow—Plants of Arizona	119
University of Iowa, by W. A. Anderson—Plants of Iowa, collected by the late Professor B. Shimek	56
University of Michigan, by C. A. Lundell—Plants of British Honduras	145

By Transfer—

Fairburn, David C.—*Abelia chinensis* R. Br. from horticulture	1
Total	1,049

SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and while virtually a private garden it was, except at certain stated times, always open to the public. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was designated by Mr. Shaw as its official title and in his will and all of his writings he specifically referred to it as the "Missouri Botanical Garden." By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will, the immediate direction of the Garden is vested in a Director, appointed by the Board of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises 75 acres, where about 12,000 species of plants are growing. There is now in process of development a tract of land of over 1,600 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees, and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a wild-flower reservation, with the idea that possibly at some future time this may become the new botanical garden.

The Garden is open to the public every day in the year, except New Year's Day and Christmas—week days from 8:00 a. m. until sunset; Sundays from 10:00 a. m. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Place, on the Sarah car line (No. 42). Transfer south from all intersecting lines.

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MISSOURI BOTANICAL GARDEN BULLETIN

Vol. XXVI DECEMBER, 1938 No. 10

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Missouri Botanical Garden Bulletin

Vol. XXVI DECEMBER, 1938 No. 10

"WHAT SHALL WE DO WITH THE CHRISTMAS POINSETTIA?"

When a garden-minded person is the recipient of a poinsettia plant at Christmas time, efforts are usually made to save the plant and bring it into bloom again the following year. But alas, sooner or later such efforts are usually doomed to fail. This is evidenced by the number of times the Garden is called upon to offer encouragement, not so much to the gardener, but to the poor poinsettia. Unfortunately it is generally too late for the Garden to play successfully the rôle of plant-doctor. The doctor knows only too well that the patient is growing pale and is rapidly becoming bald and that these ills have occurred in rapid succession after a severe chill in September. It seems the patient had been reveling outdoors in the sunshine all through the summer and was the most robust member of the garden inhabitants, but now, as Christmas approaches, it is evident he will not survive to enjoy the holidays. So what can be done? Well, we shall try to tell you.

When the poinsettias grace the festive table see that they are watered. The red bracts, which we call flowers but which, to be a little technical, are only modified leaves, will remain in good condition for about a week if the plants are kept in a warm room of seventy degrees or more. If the plants are chilled at any time the leaves will soon yellow and drop.

Question: What shall be done with the bare plants after Christmas?

Answer: Lay the plants away in the cool part of the basement until May and do not water them. Most persons are reluctant to destroy them. Somewhere they have read, or someone has told

them, how luxuriantly they grow in California, Texas, and the other southern states—so why not here? We agree with the gardener that a poinsettia, represented by a bare stick planted in the garden in May, will grow faster than any other house plant. That the northern gardener cannot bring them into bloom is due to the change in weather in September, which necessitates moving the plants indoors. This is the critical time in the life of the poinsettias. Those that were taken out of the pots in the spring and planted in the flower border will have grown so large that it is impossible to lift them without disturbing the roots. What happens? All of the leaves will drop within a week after lifting and there will be no flower bracts.

Question: If the plants should not be taken out of the pots in the spring, then what should be done?

Answer: In May cut the bare stems back to six or eight inches above the rim of the pot. Shake some of the soil from the roots and re-pot into a six- or seven-inch pot. See that there is some broken crock over the hole in the bottom of the pot and use good garden soil. If the soil is heavy add sand and thoroughly mix it with the soil. After re-potting the poinsettias, water them, then plunge the pots outdoors in a sunny position, in cinders or soil about three inches deep. Within a few weeks several shoots will appear, two or three of which should be kept and the others removed. These branches will grow quite tall in one season and must be tied to a support, preferably a bamboo cane. It is not absolutely necessary to start the plants in May. They may be started in June and even early July. Late planting will prevent the poinsettias from growing too tall, but weak plants that have been kept dormant too long often fail to grow. The pots should be lifted occasionally. If this is not done, a large root may grow through the hole of the pot into the soil beneath, and the severing of this root will cause all of the leaves to drop when the plant is lifted in September.

A better way to grow poinsettias, and one more fascinating because it requires skill, is to start new plants from cuttings in the early summer; in fact, that is the way the commercial grower produces poinsettias for Christmas. He would never think of growing old plants a second and third year. If poinsettias are to

be grown from cuttings, the stock plants should be brought into the light in May or June, the stems cut back to a foot above the pot, and the plants given a thorough soaking. Syringing the stalks whenever possible will soften the wood and hasten the de-

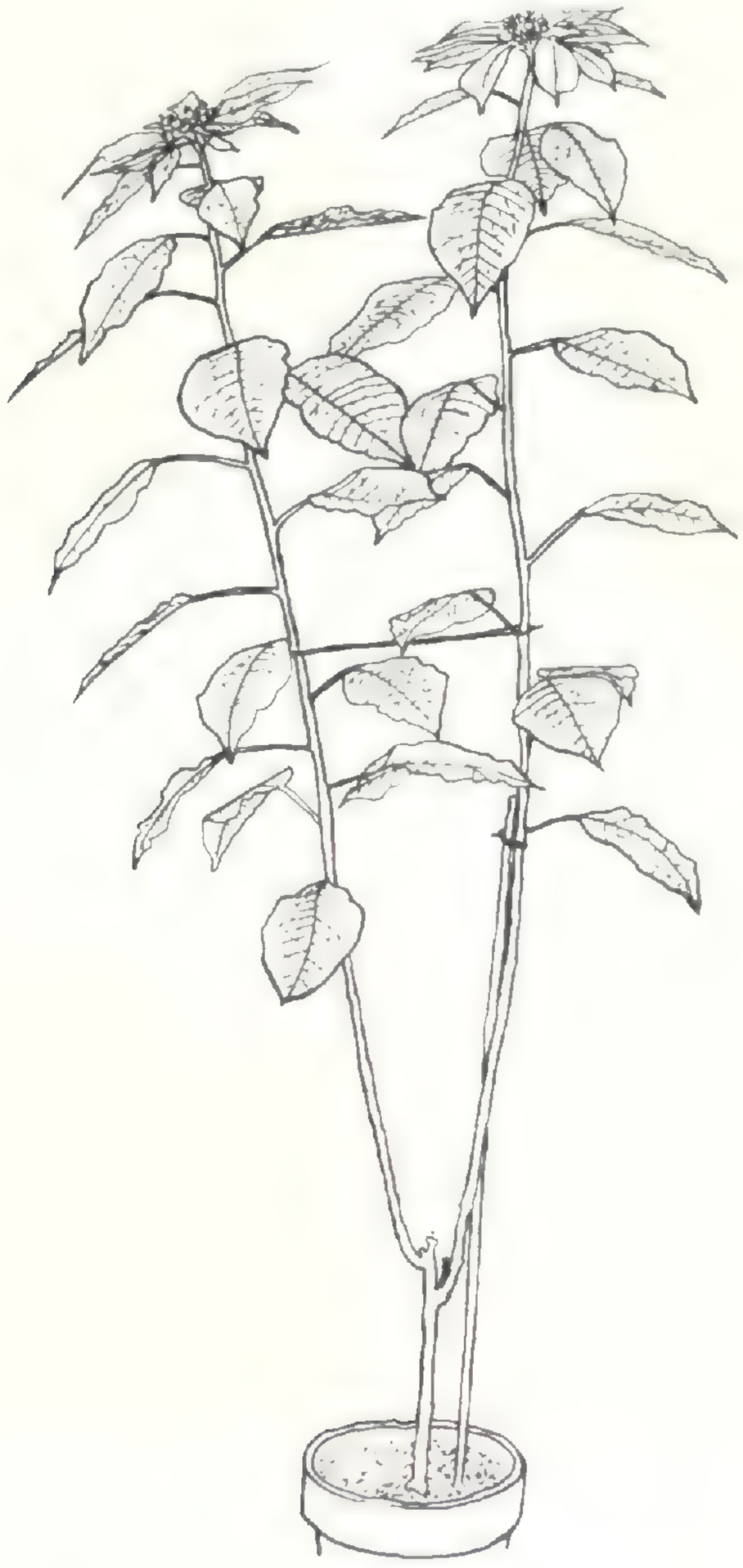


Fig. 1. Poinsettia plant cut back and grown a second year.

velopment of the eyes. Cuttings will be available in June and July, which are the two best months to root them. Those rooted in August will yield small plants with imperfect bracts. Cuttings are removed from the stock plants when they are four or five inches long, a stub at least an inch long being left to permit secondary

Fig. 2. Rooted poinsettia cuttings.

sprouts to develop for later cuttings. As soon as the cuttings are cut from the stock plants they are dropped into a bucket of cool water to prevent "bleeding." Poinsettias belong to the family Euphorbiaceae, and many members of this family contain a heavy, milk-white sap which flows from the plant as soon as it is cut. Later, when the surplus leaves have been removed and a fresh cut is made beneath a node, they are again placed in water. After

Fig. 3. Center of poinsettia: A, stamens; B, pistil; C, nectar gland.

fifteen or thirty minutes they are planted in pots or boxes of sand which has been watered and tamped. Make an opening in the sand with a dibble, about the size of a lead pencil, place the cutting two inches deep, and pack the sand around it. When all of the cuttings are in place, water thoroughly to settle the sand and shield them from the wind with paper or burlap. In the second week a little more air is admitted to the propagating box, and later it is left uncovered each night. Cuttings in well-drained boxes should be watered each morning and the foliage sprayed several times a day during the first two weeks. After three or four weeks, at which

Fig. 4. Seed pod of poinsettia.

time the cuttings should be rooted, they are potted into 2½-inch pots of light soil composed of garden soil, leaf-mold, and sand. They are again shielded from the sun and wind for a week or more until root action has taken place. From then on the young plants will grow rapidly and must be shifted into four- and five-inch pots when numerous roots reach the sides of the pots.

Poinsettias grown outdoors must never suffer from cold. A succession of chilly nights in August and September will cause the plants to shed their leaves. In the house, grow the plants in a southern window or sunroom and in a temperature that never

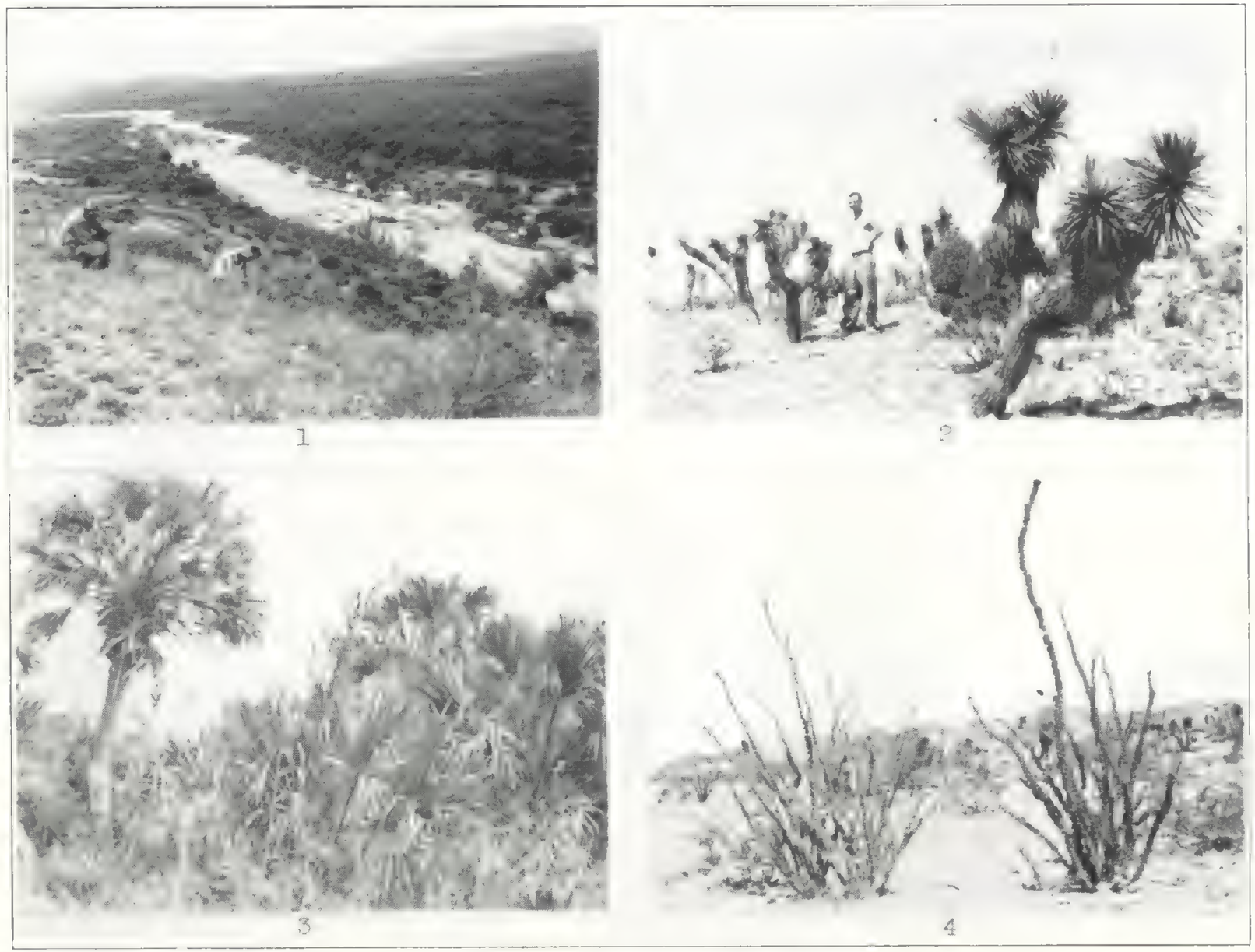
registers less than sixty degrees. If these conditions cannot be supplied, save your time and effort for the culture of other worthwhile plants that are less exacting in their requirements.

It will be news to many gardeners to know that poinsettias can be grown from seeds. True, seeds are seldom listed, but there are American and English catalogs that do advertise poinsettia seeds for two cents apiece. The seeds are large, and there is no difficulty in germinating them. Those sown in early June will give plants four feet high, and there will be very little difference between these plants and those grown from cuttings.

As has been previously mentioned, the colorful portion of the poinsettia is composed of bracts, which are modified leaves. The true flowers are inconspicuous and are located in the center of the cluster. Some of them contain only the stamens and others only the pistils. The line-drawing (fig. 3) clearly shows the structure of the central portion of a poinsettia, and if anyone is inclined to experiment he should take some of the stamens and rub the pollen onto the pistils. This should be done more than once in order to insure pollination, and it would be well to transfer the pollen from one plant to another as the poinsettia is said to be self-sterile. If the pollination has been carefully done, a large fat seed pod should form within a short time (fig. 4). The seed should be ripe in about four months. It is then stored until June when it may be sown in pots of sandy soil. Plants started from seed are treated the same as those grown from cuttings. P. A. K.

REPORT OF A PLANT HUNT IN TEXAS

Once upon a time the silent desert of the Southwest was a scourge for the pilgrim. Only the bold adventurer, prospector, and trapper had the nerve to explore the mysteries which the desolate wastes had to offer. To most people the desert represented terrifying sandstorms, venomous reptiles, vicious thorn-covered plants, unbearable heat, parched throats, and perhaps death in a God-forsaken country. Today all such unsavory thoughts have been removed. True, it is still a rugged, forbidding, and austere region, but excellent roads and automobiles have brought a little



1 2 3 4

DESERT PLANTS IN THE SOUTHWEST

1. Creosote bush desert bordering Maravillas Creek, on the Roberts' Ranch. 2. Typical desert yucca *(Yucca elata)* of Texas, south of Fort Stockton. 3. *Sabal texana* in the Rabb Palm Grove, southeast of Brownsville, Texas, the only natural palm jungle in Texas. 4. Ocotillos *(Fouquieria splendens)* in desert country south of Fort Stockton, Texas.

closer all the fascination and mystery that the desert encloses, and more and more tourists flock each year to the wonderland of the Southwest.

To the botanist, nature-lover, artist, photographer, and pleasure-seeker, the desert is indeed intriguing. It offers myriads of bizarre, thorn-covered, and exquisitely colored plants that courageously cling to life under the most trying conditions, hundreds of picturesque canyons, crumbling historic ruins, weird natural formations, landscapes draped with marvelous colors that no artist can successfully duplicate, opportunities for desert treks and canyon climbs, and, last but not least, sunshine and invigorating air to health-famished bodies. And so the writer, who is preponderantly desert-minded, made an opportunity to visit western Texas, chiefly to gather some valuable data about the cacti of that region, but also to obtain plants not already in the Garden's collection or that were conspicuous by their rarity. Several outstanding succulent gardens and institutions in the lower Rio Grande valley were visited, and outstanding xerophytic plants were photographed in their natural habitats. To say the least, the trip proved very fruitful and was highly thrilling from start to finish.

The first camp-site of importance was established on top of the picturesque Arbuckle Mountains in south-central Oklahoma, about fifty miles north of the Texas border. These low granite mountains are very rugged and harbor vegetation of the semi-desert type. A winding, ascending highway leads to a thousand-foot elevation from which a breath-taking view of Turner Falls is to be had. These falls, issuing from the waters of Honey Creek, are the foremost attraction of the region. A few miles east of them, on the road to the spectacular Price Falls, the rough, stony hillsides revealed an abundance of the white-spined hedgehog cactus, *Echinocereus Reichenbachii*. Frequently called "lace cactus" because of its delicate spine clusters, this plant prefers limestone hillsides where it blends perfectly with the white surroundings. A pincushion type of cactus, possibly *Coryphantha vivipara*, although not definitely identified to date, also was found in this vicinity. It was indeed scarce, for only one plant rewarded our diligent search of several hours. In the souvenir shops along the

Opuntia Lindheimeri in a typical mesquite desert south of Laredo, Texas.

Desert vegetation on slopes of Doubtful Canyon.

DESERT PLANTS IN THE SOUTHWEST

highway another pincushion was much in evidence, one of the species of Neobesseya. It no doubt grows in the hills and in plenty, and yet not a single specimen showed itself when we combed the stony hillsides for miles around. The common prickly-pear cactus grew precariously on the rugged slopes, and *Yucca glauca* dominated the scene several miles south of Turner Falls.

The Big Bend country, located within the giant curve of the Rio Grande River in Texas, is a land of picturesque mountains, canyons, and mesas. It is one of the few remaining wild domains within the borders of the United States, and is grown over with creosote bush, mesquite, Spanish dagger, sotol, lechuguilla, cactus, and other desert vegetation. A good deal of the collecting and photographing was done in the vicinity of the Santiago Mountains, with headquarters established on the Roberts ranch. The rocky slopes of Doubtful Canyon presented some very strange-looking assortments of plants. Growing in fissures of gigantic rocks that had tumbled down from above, *Dasylirion texanum* seemed contented in its surroundings. This is the common sotol plant of the Big Bend, conspicuous by its ornamental rosettes of long, narrow, spine-edged leaves. The ocotillo, *Fouquieria splendens,* with its wand-like, thorny stems shooting from a slender base is a characteristic desert species that can be found on rocky hillsides throughout the Southwest. Several miles from the mouth of the canyon and about half-way up the slope, a dazzling colony of the straw-colored *Echinocereus stramineus* glistened in the sun. Nestling in the shade of the overhanging limestone were clumps of *Escobaria tuberculosa,* a delicate white-spined cactus not yet showing its characteristic red fruits. High above, along the canyon rim, the candelillo, *Euphorbia antisyphilitica,* made its appearance. This is the famous wax plant of the Mexicans, the source of a well-known high-lustered vegetable wax. The lechuguilla *(Agave Lechuguilla),* although not so common on the canyon walls, nevertheless is a dominant plant in the Big Bend region. It seems to prefer the limestone debris-covered country drained by the tortuous Pecos River, and at one time it was estimated that its range covered 20,000 square miles of Texas territory. The floor of the canyon was luxuriant in several places with various thorny shrubs, among which were several species of Acacia. Conspicu-

ous also was guayacan, *Porlieria angustifolia,* a rigid evergreen shrub whose flowers are attractive to the honey bees. The Mexican buckeye, or *Ungnadia speciosa,* was likewise growing there.

In the flats bordering the foothills of the Santiagos, in a typical creosote-bush desert, several of the odd carrot-tubered *Peniocereus Greggii* were dug up. This is a fragrant night-blooming cactus with a relatively large storage root, and at this time it was in fruit. The fruit, a scarlet berry, contained very little seed, as it had been rifled by a hungry rodent and only the bright shell remained, still attached to the slender gray-green stem. The peniocereus was often found beneath the brush of *Koeberlinia spinosa,* a most peculiar bush that seemed to be practically all thorns. Several young plants of the latter, as well as the showy Apache plume *(Fallugia paradoxa)* and agarita *(Berberis trifoliata),* were collected with elongated roots for the Garden's desert collection, but they did not survive the trip.

The steep rock-strewn banks of Maravillas Creek were resplendent with several species of blooming plants, the most conspicuous being *Tecoma stans* var. *angustifolia,* with its large trumpet-shaped yellow flowers. Then there was the succulent *Echeveria strictiflora,* which has delicate light gray-green foliage and long stalks of pink and yellow bells. Although several species of small cacti were plentiful they were difficult to locate. However, when one plant was discovered the immediate vicinity revealed hundreds of the same curious plant. The living rock, *Ariocarpus fissuratus,* growing in the driest soil, often shrivels into the ground, and because of this condition and its mimic coloring, it is extremely hard to detect. In late summer when lovely rose-colored blossoms emerge from the center of the flat top it truly becomes the "living rock." Keeping company with this plant is the mule crippler, *Echinocactus horizonthalonius,* a small hemispherical barrel cactus also quite plentiful. The gravel hills and limestone ridges bordering Maravillas Creek are likewise strewn with a yellow-spined variety of *Thelocactus bicolor,* several of the plants blooming at the time of our visit. A diligent search revealed one beautiful crest which is now in the Garden collection. *Echinocereus dasyacanthus,* the Texas rainbow, although not so plentiful, was detected in several places almost hidden by the tall surround-

ing grass. A large showy three-headed specimen was found and dislodged. *Echinocereus chloranthus,* another rainbow-type cactus, is common in the country south of Marathon. Seedling plants are covered with long white hairs, like the old-man cactus, but these disappear in age.

Within a radius of about two miles of the ranch house several interesting plants were observed. A verbenaceous plant, *Lippia ligustrina,* called "white brush" by the natives, was fairly abundant. This is a tall slender-branched bush copiously covered with small white fragrant blossoms, a source of excellent bee-food. Low scrubby growths of the curious *Ephedra Reedii* occurred in the dry rocky ground, often in company with the catsclaw, *Acacia Greggii.* The showy Indian paint-brush, *Castilleja lanata,* grew in sparse communities among creosote bushes, and in the same locality innumerable plants of *Boerhaavia linearifolia* seemed contented. A small scrubby evergreen with grayish bark and clusters of tiny flowers, *Bumelia* sp., was conspicuous. *Yucca macrocarpa,* the common wide-leaved Spanish dagger, appeared less frequently, as well as several species of cacti, including *Opuntia imbricata, O. leptocaulis, Coryphantha macromeris,* and *Neomammillaria meiacantha.*

Leaving the Big Bend country in a gradual southeasterly direction from Sanderson there stretches a vast desolate, arid plain which becomes monotonous even to the most rabid desert fan. The vegetation consists of yuccas, opuntias, lechuguilla, and ocotillo. Approaching the Pecos River, east of Langtry, we came upon a very picturesque deep narrow side canyon leading down to the Rio Grande, where a plant collection was made and several photographs taken. Working a way (with some difficulty) down to a narrow ledge overhanging an almost perpendicular wall, the writer was successful in dislodging a clump of *Echinocereus enneacanthus,* which suspended precariously over the rim some 60 or 70 feet above the water-worn canyon floor.

Following the Rio Grande southward for almost 250 miles the next important stops were Laredo, where several hours were consumed in photographing outstanding cactus plants at the Shiner Cactus Nursery, and Dr. W. E. Lowry's cactus garden. Several miles south of Catarina, in Dimmit County, the low hills adjoining

the road were covered with an extremely attractive bush having silver-green foliage and abundant bell-shaped violet flowers. The bush proved to be *Leucophyllum frutescens,* or "ceniza" as it is commonly called by the Mexicans. It is becoming very popular in Texas where it is much used in gardens and roadside plantings. Several miles south of Edinburg, in Hidalgo County, is located the famous Rio Grande Valley Cactus Garden, belonging to the Pirtle family. Begun as a hobby eight years ago their collection has grown by means of exchange and purchases, until today the garden comprises three acres and includes approximately 1,500 species of succulent plants. It is really amazing with what rapidity the Mexican and South American cacti grow there. An outstanding example is the prickly nopal, *Nopalea Brittoni.* Started from a single pad five years ago it has grown into a wide-spreading tree with several trunks about twelve inches in diameter arising from a common base.

In a mesquite thicket, several miles north of Brownsville, large colonies of the twisted-rib cactus, *Hamatocactus setispinus,* were discovered by accident. Growing with them, but less numerous, were the "tasajillo," *Opuntia leptocaulis,* and an unidentified platyopuntia. Rabb Palm Grove, located seven miles southeast of Brownsville, was visited and several good shots of the jungle growth taken. *Sabal texana* was predominant in a small area, which is the only natural palm jungle in Texas.

Summarizing the trip, living collections of cacti were gathered in the Arbuckle Mountains of Oklahoma and in the Big Bend region of Texas. Herbarium material of non-succulent plants was obtained from four conspicuous locations in Texas, namely: the sand desert in Crane County, near the county seat; the desert bordering the Marathon Road south of Fort Stockton in Pecos County; the Roberts' ranch bordering the Santiago Mountain chain; and southern portion of Padre Island, off the coast of Texas. Much of the dried material was determined by the Misses Maude C. Lodewyks and Betty Ammerman of the Missouri Botanical Garden. The historic Padre Island boasts such interesting plants as *Limonium brasiliense, Samolus cuneatus, Cladothrix lanuginosa, Dondia intermedia, Uniola paniculata, Sesuvium portulacastrum,* and several others. L. C.

A HEDGE OF ORCHIDS

In the Missouri Botanical Garden Tropical Station, at Balboa, Canal Zone, there is a long hedge of orchids of which the Garden is justly proud. Recently, in Sue Core's column, one of the Panamanian newspapers described the Tropical Station and orchid hedge as follows:

> Yesterday we were doing a mental jitterbug act about the orchid garden in Balboa, when we came to the end of our thread and had to stop. We hadn't even started to tell you about what we found when we visited that lovely and interesting nook at the urgent invitation of Director Allen.
>
> An Isthmianite breaking down and admitting he has never been to the orchid garden is almost as disgraceful as saying he has never seen a ship go through the locks. It was the truth, however, where we were concerned. The loss has been ours . . . because we have certainly been missing some of the loveliest sights to be seen on this Isthmus. And so have you, if you, too, have not been one of it regular visitors.
>
> . . . There you find yourself in a veritable world apart. A long, canyon-like park stretches ahead, with a path leading into an infinitude of green in the distance. Everything is sort of hushed and still in there, with the most bewildering array of plant life this side of Summit Gardens. Orchids? Literally thousands of them. Orchids in little glass houses and orchids swinging from the meshes of outdoor trellises. Orchids on posts and orchids on stands. Some gayly blossoming and others in the resting stage. But—orchids everywhere.
>
> The outstanding feature of the day, however, was a bed of these purple orchids; the ones with such heavenly shades and odors to them. There was a hedge of them at least a block long, which had thousands of blossoms smiling at the sun. Nothing on earth could have been lovelier.
>
> The regrettable feature about this particular orchid is that it stays in bloom only one day. It makes up for this lack of accommodation, however, by strutting its stuff every three weeks. Because its opening can be foretold almost to the hour, we intend to ring you in on the treat next time it is available. Mr. Allen has promised cross-his-heart-and-hope-to-die that he'll let us know in time to tell you about it.

At our request Mr. Paul H. Allen, Manager of the Tropical Station, has written the short description of the hedge and the species which are used in it:

"The Tropical Station of the Missouri Botanical Garden is situated on one of the heaviest tourist traffic belts in the world.

TWO VIEWS IN THE COUNTRY OF THE WHITE SOBRALIA

Consequently, one of its most perplexing problems has been that of providing large quantities of blooming orchids for visitors. The requirements for an ideal show plant are rather exacting, since they necessarily have to be grown out of doors with a minimum of care and of protection from insect pests. It was soon found that the public was not interested in the smaller-flowered botanical varieties or small or mixed lots of any kind. Evidently what was needed was something obtainable in large quantities, which could be depended upon to bloom consistently at one time.

"A great number of the South American and East Indian species of orchids were eliminated either for reason of shyness of bloom, difficulty of obtaining plants in sufficient quantity, or most commonly because the plants came from too great altitude to thrive in the warm moist climate of the Station. The orchid Sobralia seemed to come nearest to meeting all the requirements, and fortunately it is well represented in Panama, both in species and quantity. It has no serious insect enemies, grows with a minimum of care, and flowers with the regularity of clockwork during the months of September to December. About three weeks is the usual flowering period, and bloom can be foretold to the day nearly a week in advance, giving ample time in which to notify tourist agencies and the public.

"After some experimentation, a hedge of *Sobralia panamensis,* a lavender-flowered species, was established along the main walk leading in to the Station grounds. The first hedge was 120 feet in length. Some of the plants with long canes were mounted on piles of stones, as they are frequently found growing in the wild. This hedge carries nearly a thousand flowers on a show day and perfumes the air for a considerable distance around. Other scattered clumps of Sobralia in the grounds help to continue the effect, as well as considerably augmenting the number of blooming plants.

"During the past year an additional 60-foot hedge has been planted with *Sobralia leucoxantha* (?), another showy species. Fortunately this species opens its giant white flowers on the same day as the smaller *S. panamensis,* although it comes from a different section of the Republic and grows under entirely different conditions. *Sobralia panamensis* is commonly found in nature on immense limestone boulders, in rather dense shade, at

Packing white sobralias out to the road.

Hedge of sobralias at Tropical Station, Panama, C. Z.

sea-level. *Sobralia leucoxantha* comes from a region of volcanic "badlands" nearly seventy-five miles distant. It grows exposed to the full force of the sun on cliffs of volcanic ash, at an elevation of about a thousand feet."

NOTES

Mr. L. P. Jensen, Manager of the Garden Arboretum, has been re-elected president of the Henry Shaw Gardenway Association.

Dr. David C. Fairburn, Horticulturist to the Garden, has an article in the December issue of *Real Gardening* on "The General Care of House Plants."

Mr. George H. Pring, Superintendent of the Garden, spoke before the members of the Rosemary Garden Club, November 17, on "Plants of Economic Value."

Dr. Hermann von Schrenk, Pathologist to the Garden, gave a talk before the Canadian Railway Club, at Montreal, November 14, on "Timbers As Used by Railroads."

Mr. L. P. Jensen, Manager of the Garden Arboretum, gave a talk before the Wayside Garden Club of Manchester, Mo., November 14, on "The Country Roadside Improved"; and at the anniversary dinner of the Greater St. Louis Association of Gardeners, at Maplewood, Mo., November 19, on "The Joy of Gardening."

The fourth number of Volume XXV of the *Annals of the Missouri Botanical Garden* has been issued with the following contents: "Studies of South American Senecios—II," J. M. Greenman; "Contributions toward a Flora of Panama. II. Miscellaneous Collections during 1936-1938," Robert E. Woodson, Jr. and Russell J. Seibert; General Index to Volume XXV.

Mr. Ladislaus Cutak, in charge of Succulents at the Garden, has had two articles appearing in magazines during November: *Desert Plant Life*, of which he has been recently appointed a contributing editor, contains an article on "Succulents in the Home"; and *The Cactus and Succulent Journal of America* has reprinted "*Aloe vera* as a Remedy for Burns," from the December, 1937, BULLETIN.

Mr. Cutak gave an illustrated talk before the Washington University Society of Asklepios, November 14, on "Searching for Botanical Treasures in Texan Deserts."

Recent visitors to the Garden library include: Mr. Milford Benham, Teacher of Science in the De Kalb Township High School, De Kalb, Ill.; Dr. Paul Mangelsdorf, Vice-Director, Texas Agricultural Experiment Station, College Station, Texas; Mr. Julian Neill, Teacher of Science at the Smithton High School, Smithton, Ill.; Dr. Harry J. Fuller, Assistant Professor of Botany, Dr. Oswald Tippo, Assistant Professor of Botany, and Dr. F. L. Wynd, Assistant Professor of Botany, all of the University of Illinois, Urbana, Ill.; Dr. H. W. Rickett, Associate Professor of Botany, Dr. E. E. Naylor, Assistant Professor of Botany, Mr. J. T. Middleton, Graduate Assistant, and Mr. and Mrs. Chris. Schmidt and Miss Belcher, graduate students, all of the University of Missouri, Columbia.

STATISTICAL INFORMATION FOR NOVEMBER, 1938

GARDEN ATTENDANCE:

Total number of visitors	50,338

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	17
Total number of books and pamphlets donated	343

PLANT ACCESSIONS:

Total number of plants and seed-packets received as gifts	59

HERBARIUM ACCESSIONS:

By Purchase—

Botanical Museum, Harvard University, by L. O. Williams—Orchids of Mexico	100

By Gift—

Anderson, E.—Plants of Missouri	2
Conard, Henry S.—Mosses of Iowa	100
Cory, V. L.—Plants of Texas	22
Demaree, Delzie—Plants of Arkansas	27
Drushel, J. A.—Plants of eastern United States	100
Erwin, A. T.—*Cucumis Melo* L. var. *Dudaim* (L.) Naudin from horticulture	1
Fuller, George D.—Plants of Alberta, Canada	10
Greenman, J. M.—Plants of Missouri	106
Heising, Clara—Plants of horticulture	4
Little, Elbert L., Jr.—*Rhizocarpon geographicum* from Arizona	1

Looff, Ethel H.—Plants of Alaska	6
Nelson, A. L.—*Usnea Evansii* Motyka from West Virginia	1
New York Botanical Garden—Plants of British Guiana	18
U. S. Department of Agriculture by Robert F. Martin—Plant from horticulture	1
By Exchange—	
Barkley, Fred A.—Plants of Montana	400
Cornell University—Plants of Whatcom Co., Washington	140
U. S. National Museum—Miscellaneous duplicates	74
University of Florida, Agricultural Experiment Station—	
Fungi of Florida	41
University of Montana, Plants of Montana	109
Total	1,263

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SOME FACTS ABOUT THE GARDEN

The Missouri Botanical Garden was opened to the public by Mr. Henry Shaw about 1860. From that date to the death of Mr. Shaw, in 1889, the Garden was maintained under the personal direction of its founder, and while virtually a private garden it was, except at certain stated times, always open to the public. Although popularly known as "Shaw's Garden" the name Missouri Botanical Garden was designated by Mr. Shaw as its official title and in his will and all of his writings he specifically referred to it as the "Missouri Botanical Garden." By a provision of Mr. Shaw's will the Garden passed at his death into the hands of a Board of Trustees. The original members of the Board were designated in the will, and the Board so constituted, exclusive of certain ex-officio members, is self-perpetuating. By a further provision of the will, the immediate direction of the Garden is vested in a Director, appointed by the Board of Trustees. The Garden receives no income from city or state, but is supported entirely from funds left by the founder.

The city Garden comprises 75 acres, where about 12,000 species of plants are growing. There is now in process of development a tract of land of over 1,600 acres outside the city limits which is to be devoted to (1) the propagation and growing of plants, trees, and shrubs, designed for showing either indoors or outside, at the city Garden, thus avoiding the existing difficulties of growing plants in the city atmosphere; (2) gradually establishing an arboretum as well as holding a certain area as a wild-flower reservation, with the idea that possibly at some future time this may become the new botanical garden.

The Garden is open to the public every day in the year, except New Year's Day and Christmas—week days from 8:00 a. m. until sunset; Sundays from 10:00 a. m. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Place, on the Sarah car line (No. 42). Transfer south from all intersecting lines.

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